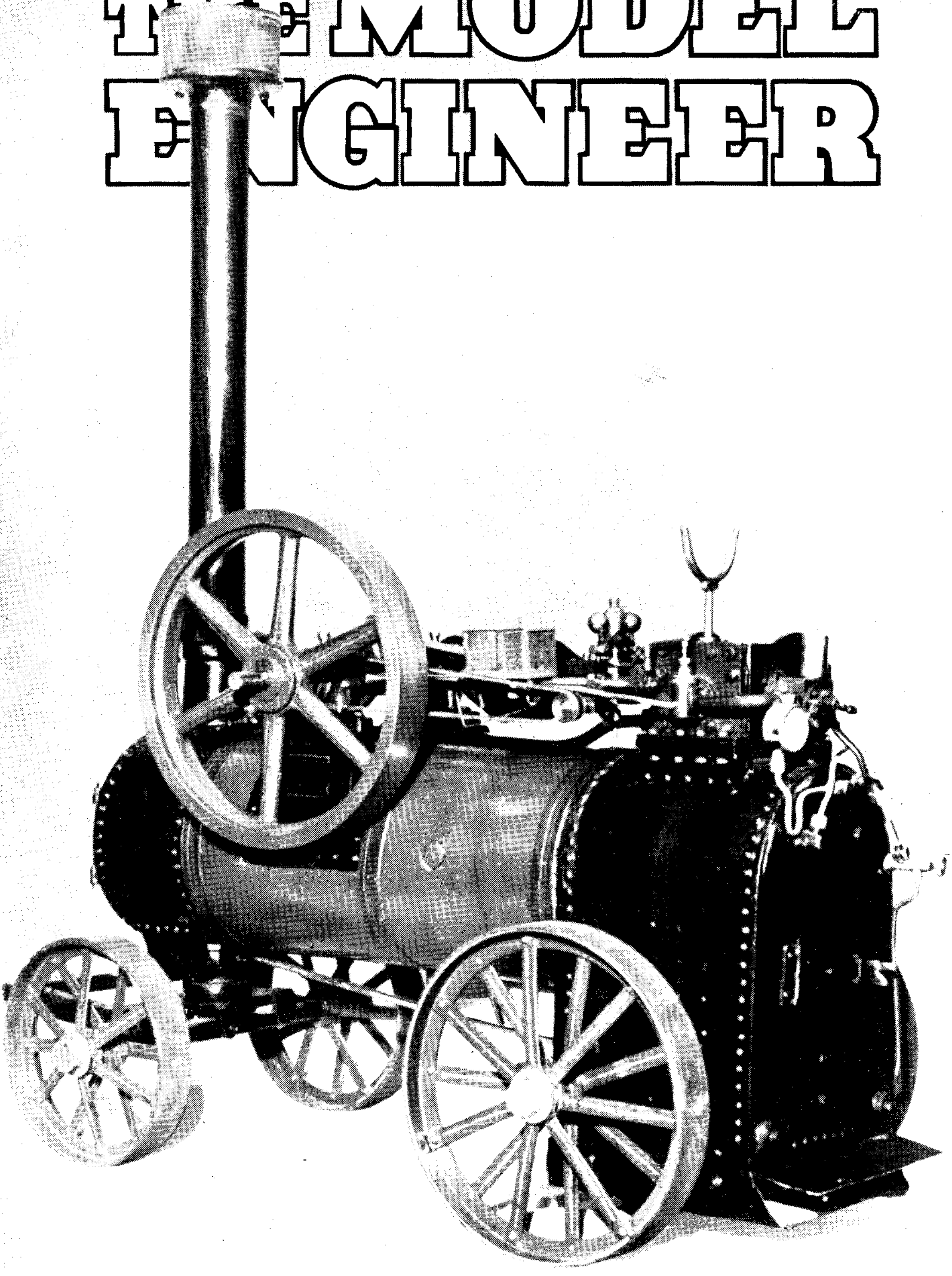
THE MODEL ENGINEER



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The MODEL ENGINEER

PERCIVAL MARSHALL & CO. LTD., 23, *GREAT QUEEN ST., LONDON, W.C.2*

27TH APRIL 1950 VOL. 102 NO. 2553

SMOKE RINGS

Our Cover Picture

● READERS WILL remember that we published on the cover of our issue dated November 25th, 1948, a fine photograph of a portable engine at work. The present photograph shows an impressive model portable engine built by Mr. W. G. Wilkinson, a member of the Sheffield S.M.E.E. A full description of the engine is given in this issue.

The Second "Tamworth Centre"

● THIS YEAR'S exhibition of model and artistic work, to be held at the Assembly Rooms, Tamworth, from June 21st to 24th, will follow as near as possible the carefully prepared plan that made the 1949 show the success it deserved to be. The intention is that each year the plan will be augmented by incorporating any new ideas, improvements and innovations that members offer to the committee for approval. Several suggestions have been approved. Chief amongst these is the "Championship Class" for engineering models that have won a first prize in a public exhibition, including any "M.E." London show. Once again it is hoped to have the generous support of the surrounding societies with their loan and competition models.

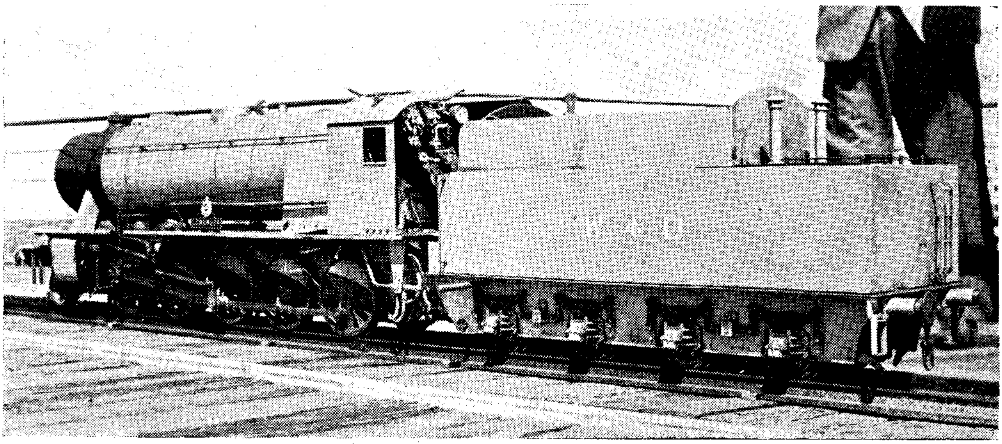
The time is approaching when the interchange will have to be on a nation-wide basis and not just a local one. There are probably many other show committees that will agree that models from the south, east, west and the north, including Scotland, will freshen up and add to the general interest of any future Midland model exhibition and vice versa. Transport is the big problem but not one that model engineers cannot solve similarly to the way they deal with many other problems.

The Tamworth society will be offering as the grand prize of the show, a 1950 M.L.7 bench lathe instead of the usual "pot"; this prize will also act as first for the championship class, with suitable cash prizes for second and third. The class will be an open one for "working" engineering models, or capable of working if necessary. Anyone interested, but not sure if their model is eligible, should contact the Hon. Secretary, R. Hanson, 75, Summerfield Road, Tamworth.

Finally, a word about conditions of entry; apart from the prize qualification, the only other condition is that the model must have been completely machined by the competitor, the paint work, lining and show stand will not affect the final decision of the judges. The judges will be using a points system devised by the Tamworth society.

A Fine Miniature Locomotive

● AMONG A large number of letters that have lately reached us on the subject of cylinder port and passage sizes was one from Mr. Jos. N. Liversage, who, before the war, was a frequent correspondent. His general attitude to the various letters which were published on the subject referred to seems to be that figures and learned dissertations are unlikely to yield such convincing results as those obtained from actual observation and experience of the performance of miniature locomotives. For many years, as our older readers will remember, he has been an indefatigable recorder of actual results, and he has sent us some information as to recent observations of the work of his own locomotives.



In one instance, the engine was tested over a period during which she ran approximately 300 actual miles; the working pressure was 110 lb. per sq. in., the cut-off 50 per cent. and the average speed 8 m.p.h., in which conditions the calculated steam consumption was 59 lb. per hour. The observed results, however, showed a steam consumption of 76 lb. per hour, an evaporation of 72 lb. per sq. ft. of heating surface per hour, a fuel consumption of 23 lb. of anthracite (Phurnod) per sq. ft. of grate per hour, or 24 lb. per cu. ft. of firebox volume per hour. The amount of water evaporated per lb. of fuel was 11 lb.

The figures were about 30 per cent. more than calculated, but Mr. Liversage does not wish to imply that they are applicable to any other model, since he has no information about other people's work.

The boiler from which these figures were obtained was originally fitted with three superheater elements, but the spearhead caps and joints eroded and burnt away after about 150 miles, and they were not replaced. This made no difference whatever to the running of the engine; the load-hauling remained as good as before, and the steaming of boiler was possibly better with the flues throttled to tube size.

On the other hand, a second engine, the $1\frac{1}{2}$-in. scale Austerity 2-10-0 seen in the photograph, has nothing like the "jip" without superheaters. These, in this engine, burnt out after 500 miles; the boiler has practically no dome, whereas the other engine collects steam from a dome about 5 in. high. All this suggests that superheaters are not an unmixed blessing; in any case, the length of the boiler has some influence on the matter and must, of course, affect the temperature of the smokebox. There is, surely, great scope for practical investigation into such matters, and it adds a lot of interest to the model locomotive hobby.

Blackburn Live Steamers

● SOME TIME ago, we announced the fact that a small locomotive club had been formed in Blackburn, and we have now heard from Mr. John Fowler, the hon. secretary, that considerable activity has been going on. Incidentally, the name of the club has been changed to "The Blackburn Live Steamers" to indicate the prime interest of the members.

At present, there are twelve members, but Mr. Fowler reports good progress in the construction of the club track; a cutting has been dug and an embankment has been built. Thirty-two pillars, out of a total of eighty, have been erected and 146 ft. of track is assembled. The total length of the track will be 330 ft., and the members are hoping to finish it during the coming summer, for there are three $2\frac{1}{2}$-in. and four $3\frac{1}{2}$-in. gauge locomotives ready for running, while one $2\frac{1}{2}$-in. and no fewer than ten $3\frac{1}{2}$-in. gauge engines are under construction.

The members meet, every Friday night, in the workshop of the Blackburn Technical College, drilling the steel, making spacers, etc., and assembling sections of track. This co-operation on the part of the College authorities is very much appreciated.

Anyone in Blackburn or district who possesses or is building a locomotive for either $2\frac{1}{2}$-in. or $3\frac{1}{2}$-in. gauge, and would be interested in joining the Live Steamers, is invited to get into touch with Mr. Fowler, whose address is: 21, Nares Road, Witton, Blackburn.

A Fine Model Portable Engine

Built by W. G. Wilkinson and described by W. J. Hughes

"BILL" WILKINSON is a very popular member of the Sheffield and District S.M.E.E., and his portable engine was equally popular at the Society's 1949 Exhibition, where it was awarded first prize in its class. On the first three days of the show, it worked *continuously* for eight hours each day, and on the fourth day for twelve hours, without a stop or mishap of any kind. In fact, the chief trouble was in keeping her from blowing off continuously, and her fire had to be kept low all the time. Undoubtedly a "live steam" model creates more interest even than one working on compressed air, and we are fortunate in possessing this engine in the society.

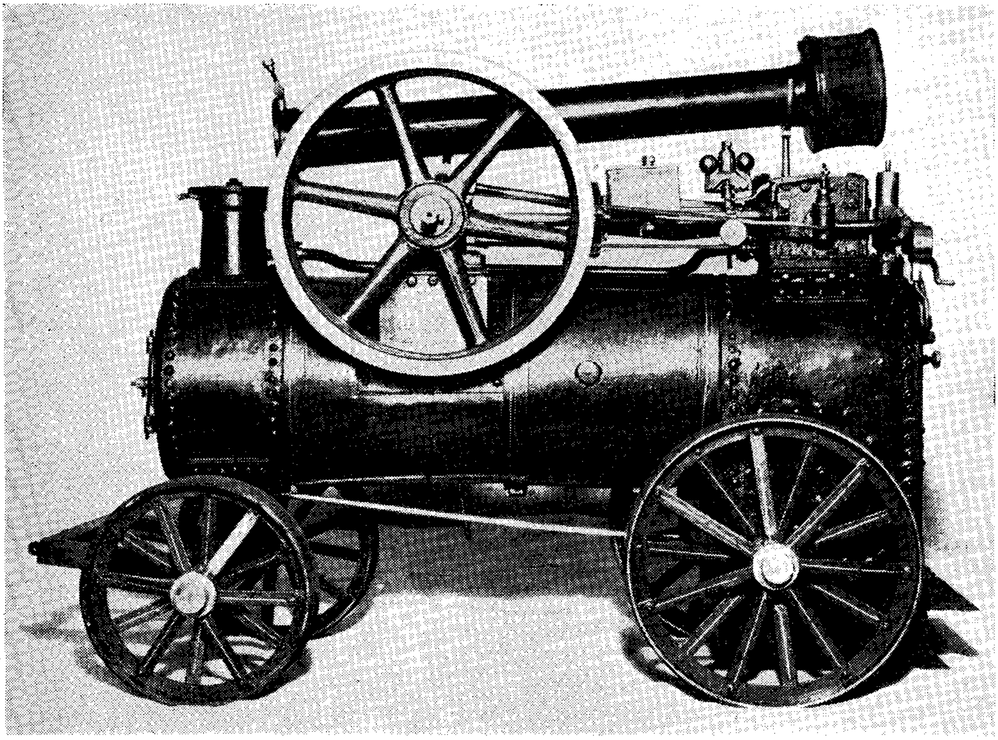


Photo by] [*Press Photo Agency*

Photo No. 1. A side view of Mr. Wilkinson's model portable engine. Points to note: exhaust pipe lying on top of the boiler; Hartnell-type governor working valve by direct-acting lever; oil pipe from mechanical lubricator

The engine will tick over at a stately cycle, but when the regulator is opened, the tempo speeds up rapidly, the flywheel spokes and the rods become a blur, and she rocks just like the prototype does under similar circumstances.

Some Principal Dimensions

From the point of size, the model is quite impressive, being 23 in. long overall, and $9\frac{3}{4}$ in. wide overall. The height to the cylinder top is $13\frac{1}{2}$ in.; the boiler is $11\frac{1}{2}$ in. between tubeplates and $5\frac{1}{4}$ in. diameter. Hind wheels are 7 in. diameter, with front wheels $5\frac{1}{2}$ in. diameter, while the flywheel is $7\frac{5}{8}$ in. diameter. All are $1\frac{1}{8}$ in. wide, by the way.

The smokebox is 3 in. long, with a door $4\frac{1}{2}$ in. diameter, hinged at the flywheel side. The chimney base is made from a "dud" cylinder casting, with a square saddle of $2\frac{1}{4}$ in. side, the outside diameter of the tubular part being tapered $1\frac{7}{8}$ in. to $1\frac{5}{8}$ in. The chimney itself is $1\frac{1}{2}$ in. outside diameter and $13\frac{1}{2}$ in. high.

The Boiler and Firebox

Rolled up from sheet, the boiler barrel is riveted and brazed. In general construction, of course, the boiler itself is of locomotive type, with a firebox outer shell $5\frac{1}{2}$ in. wide, 5 in. long, and $8\frac{3}{8}$ in. high. The inside firebox is $4\frac{3}{4}$ in. wide and $4\frac{1}{4}$ in. long; its top is 2 in. below the outer shell.

There are 28 fire-tubes $\frac{5}{8}$ in. in diameter, but Mr. Wilkinson says that in view of the engine's tendency to blow off, he would make this 14 tubes of $\frac{1}{2}$ in. diameter were he building another portable. The whole boiler assembly is riveted, and brazed or silver-soldered, and in order to provide realism there are plenty of rivets round the firebox and smokebox shells, as will be noticed.

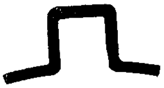


Fig. 1. Cross-section of girder strap to firebox crown

Two girder stays of the section sketched (Fig. 1) are riveted and brazed to the inner firebox crown sheet, and the sides, front and back are stayed by 88 copper stays, $\frac{3}{16}$ in. diameter, screwed and riveted *a la* "L.B.S.C." In addition, there are five central $\frac{3}{16}$ in. diameter stays supporting the firebox crown from the outer wrapper, or arch-plate, and these are screwed and silver-soldered.

On a portable, as on a traction-engine, the "front" plate is that which our locomotive friends would call the backhead, and on the model this is flanged with a pronounced radius, and actually projects $\frac{5}{16}$ in. from the wrapper sheet. This is quite characteristic of the prototype, and indeed some makers mentioned it specifically in their catalogues as leading to less likelihood of trouble with cracking, and as being easier to clean out.

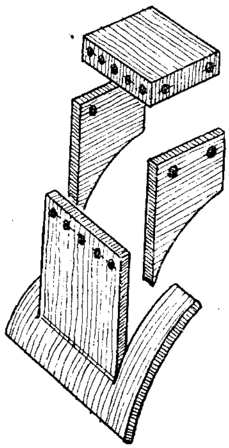


Fig. 2. Sketch to show construction of main bearing brackets

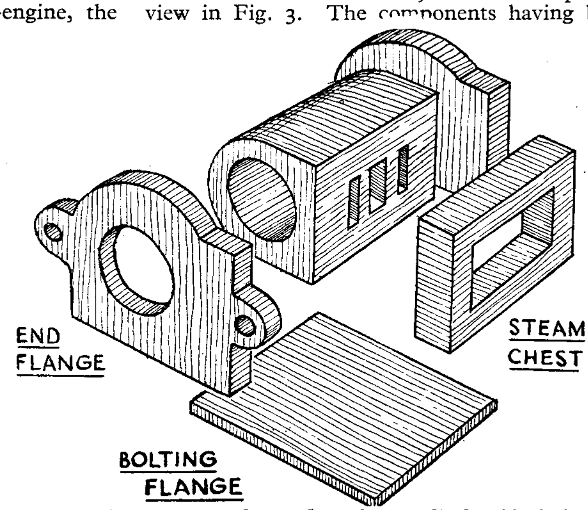


Fig. 3. Sketch to show how cylinder block is built up

An oval firehole of the Briggs type is fitted, $1\frac{7}{8}$ in. × $1\frac{1}{4}$ in., with its centre $3\frac{1}{4}$ in. from the bottom of the box. One feature *not* usual to the prototype is a hollow stay through which steam is carried to the blower from the turret which carries the safety valve and regulator. The wheel-valve and feed-pipe for this may be seen in Photograph No. 3.

Brackets for the main bearings are fabricated in the manner shown in Fig. 2, which is almost self-explanatory. The largest component is made by slitting a piece of $\frac{1}{8}$-in. copper sheet in two places with a fine saw, and bending it to the shape shown. The two ribs are silver-soldered in place, and then the cap on which the bearing rests is held by screws.

By the way, it must not be forgotten by anyone building a portable or semi-portable engine that much of the assembly must be done *before* closing up the boiler; bearing-brackets, cylinder-brackets, and other fittings must be permanently in position while the interior is still get-at-able. The same thing applies to traction-engine building, too.

Cylinder and Motion

The cylinder is another example of fabrication. The main body is a gun-metal casting, and was cleaned up, bored undersize, faced, and generally squared up. The steam-ports were marked out and cut, but the passages were not drilled at this stage.

End-flanges, steam chest and bolting-flange were cut from brass sheet, as in the exploded view in Fig. 3. The components having been pegged to hold them temporarily together, they were silver-soldered, giving a very neat and smooth cylinder-block. This was bored to finished diameter of $1\frac{3}{8}$ in., and cleaned up generally, the steam-passages then being drilled. Notice that one end-flange has two lugs to take the stays for the main-bearings. The cylinder block is bolted to two brackets shaped as in Fig. 4, which were bent from sheet and riveted to the arch-plate of the firebox.

The bearings were machined from gunmetal castings, which had a boss cast on each side. Since only one of the bosses was required on each casting (for the stay aforementioned), the surplus one was cut off, but this saved the trouble of making two separate patterns for a left-hand and a right-hand bearing. The bearings are of the pedestal type, with correct pattern split brasses held in place by caps.

Since the cylinder centre is offset to the right by $\frac{5}{8}$ in., one bearing is offset by $\frac{1}{2}$ in. also.

The reason for this offset is to allow the centre of gravity of the engine to be lowered, because the crank-dip comes more to the side, and so does not have to clear the highest part of the boiler as it revolves. Thus the centre line of the crankshaft (and of the whole engine) may be lowered.

The crankshaft of 2 in. stroke is forged from $\frac{9}{16}$ in. diameter steel, and turned to $\frac{7}{16}$ in. diameter on the journals. The valve-eccentric is driven by a slotted plate which allows for variation of the cut-off, as was frequent in the prototype (Photograph 5).

Both ends of the connecting-rod are fitted with strap, gib, and cotter. The rod swells out in the centre, and is turned and polished.

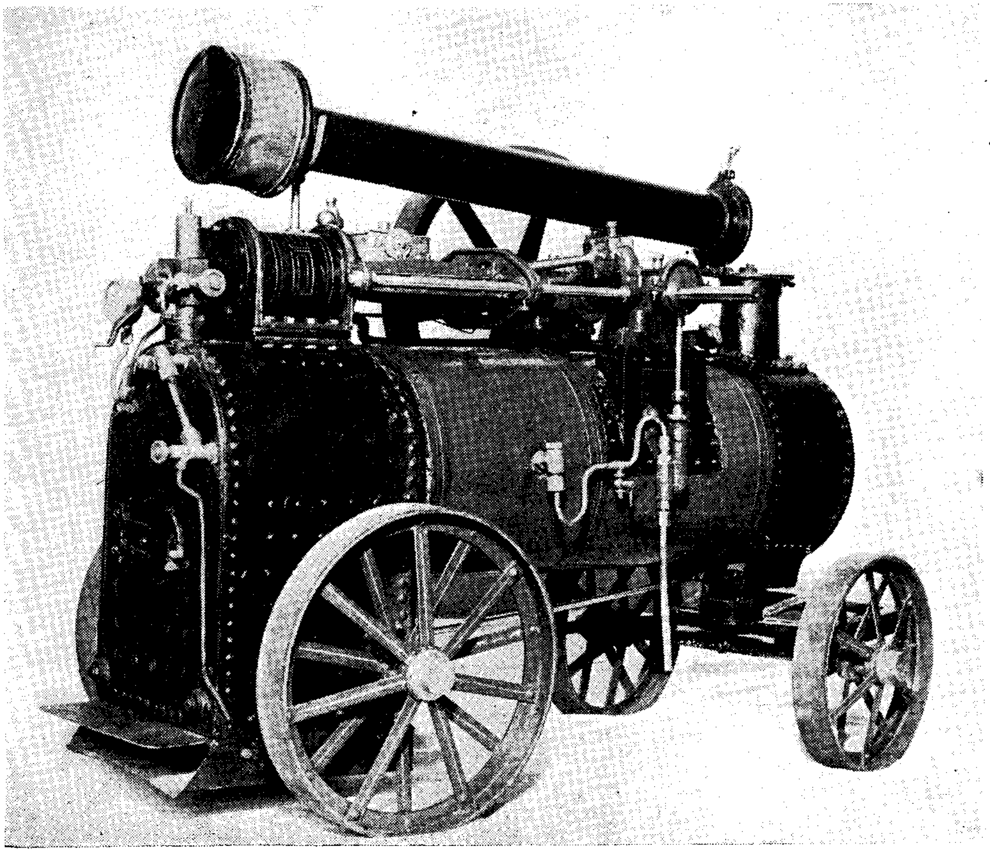


Photo by] [*Photo Press Agency*

Photo No. 2. A view which shows the mechanical details well. Points to note : brackets for cylinder-block and for main bearings ; pedestal-type bearings ; strap, gib and cotter type big-end ; turntable and perch-bracket of steerage

As in the prototype, the cylinder is stayed to the main bearings, partly for rigidity, and partly to keep the centres constant in spite of boiler expansion. To this end the bearings must be free to move slightly on their brackets ; the amount is not excessive, but the boltholes must be elongated to allow of this. The holding-down bolts must not be too tight, and must be fitted with locknuts.

These stays also carry the motion-plate, which in turn supports the outer ends of the four slide-bars. Both motion-plate and slide-bars are fabricated from steel and the construction should be pretty clear from the Photographs 4 and 5.

Carried by the right-hand bearing-bracket, and seen in Photograph 5, is a pump of $\frac{5}{16}$ in. bore and $\frac{3}{8}$ in. stroke (which will just nicely keep the boiler filled), with delivery through the clack-box on the right-hand side of the boiler. Matching this on the left of the boiler will be seen a boss (Photograph No. 1), which is to take a clack carrying the feed from an injector which has yet to be fitted.

Fore-Carriage and Wheels

The perch-bracket for the fore-carriage is riveted to the bottom of the smoke-box. Mr. Wilkinson admits that a more usual place was to the boiler-barrel (behind the smokebox),

but at the same time some full-sized portables did have the bracket in the same position as does the model, so the latter cannot be said to be incorrect.

The fore-carriage is another fabricated job, and it will be noticed (Photograph 2) that the front axle itself pivots in a fork underneath the turntable so as to allow for inequalities of road-surface. It is restrained by lugs bent down from the fore-carriage.

Fig. 4. Cross-section of bracket to which cylinder-block is bolted

On full-sized engines the hind wheels were fitted in various ways, but a favourite method was to bend each end of the axle at a double right-angle so that it fitted snugly round the throat-plate and down the firebox sides. (Inset, Fig. 5.) In the model this was accomplished by fabrication as shown in Fig. 5, which of course shows only one end of the axle. The joints were brazed, and the corners rounded after.

The wheel-rims were bent round from tee-section brass $1\frac{1}{8}$ in. wide and $\frac{1}{8}$ in. thick, the joints being silver-soldered. The spokes of $\frac{5}{16}$ in. $\times$ $\frac{1}{8}$ in. (bare) section were riveted to the rims and screwed to the ends of the hubs, after which the gaps between them were filled with soft-solder and end-caps planted on (Fig. 6). The wheels are retained on the axles by pinned collars, which are concealed by the polished brass hub-caps. Twelve spokes are fitted to the front wheels, and fourteen to the hind wheels.

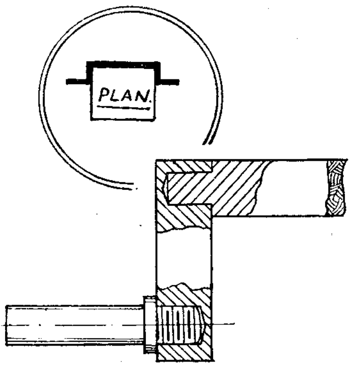


Fig. 5. Construction of "bent" hind axle, the joints being brazed. (Inset.) To show how the axle fits round the firebox

Further Details

The regulator is of the quadrant type, working in a box in front of the cylinder, mounted on the arch-plate, and a single safety-valve sits on this box. From the regulator valve steam is led to the governor-valve, and so into the steam-chest (Photograph 3). The governor-bracket is clamped to one of the motion-stays, and the Hartnell-type governor works a piston valve through a cranked and pivoted lever (Photographs 1 and 3). Also clamped to the motion-stay is an "L.B.S.C.-type" mechanical lubricator whose ratchet is worked direct from the eccentric-rod gudgeon-pin. (Photographs 3 and 4.)

My last sketch (Fig. 7) shows a "riveting-machine" which was made up to form heads on the rivets which secure the smokebox, the idea being to avoid damaging the boiler.

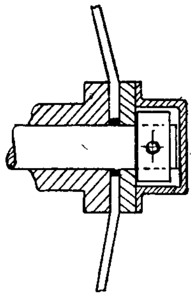


Fig. 6. How the hubs are built up. The sketch also shows how the hubs are retained on the axle

The boiler is lagged with sheet asbestos and brass, held down by brass bands, and is painted wine-colour, as are the wheels. Firebox, smokebox, and chimney are black. The engine is nicely lined out in green and gold, using cycle transfers. No attempt was made at a "super" finish, which would have been out of keeping, but the photographs do exaggerate any roughness there is. The engine was built for hard work, and has had plenty of it, for it is steamed on every possible occasion! In addition, Mr. Wilkinson's grandson, who is of a tender age, uses the model as a toy, pulling it up and down the yard with a piece of cord, and after falling on its side a few times the paintwork is not what it was!

This young gentleman, incidentally, was the principle cause of this model being built, for the owner wanted something to run for his interest—and interested he certainly is. Altogether the model took some ten months' spare time in the building. The only drawings that were made were rough sketches as the work proceeded, and the model is not of any particular prototype, but Mr. Wilkinson has fond and strong memories of a certain Robey which he knew in his youth.

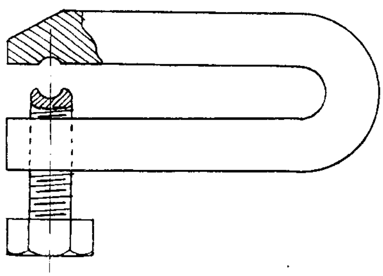


Fig. 7. "Riveting-machine," or press for heading rivets without hammering

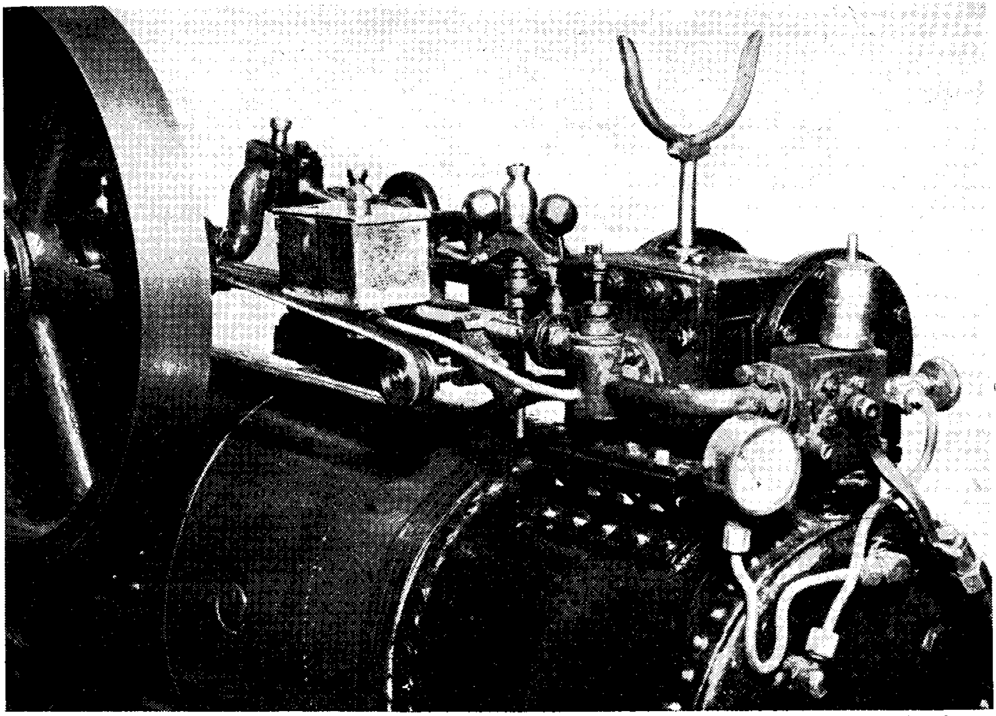
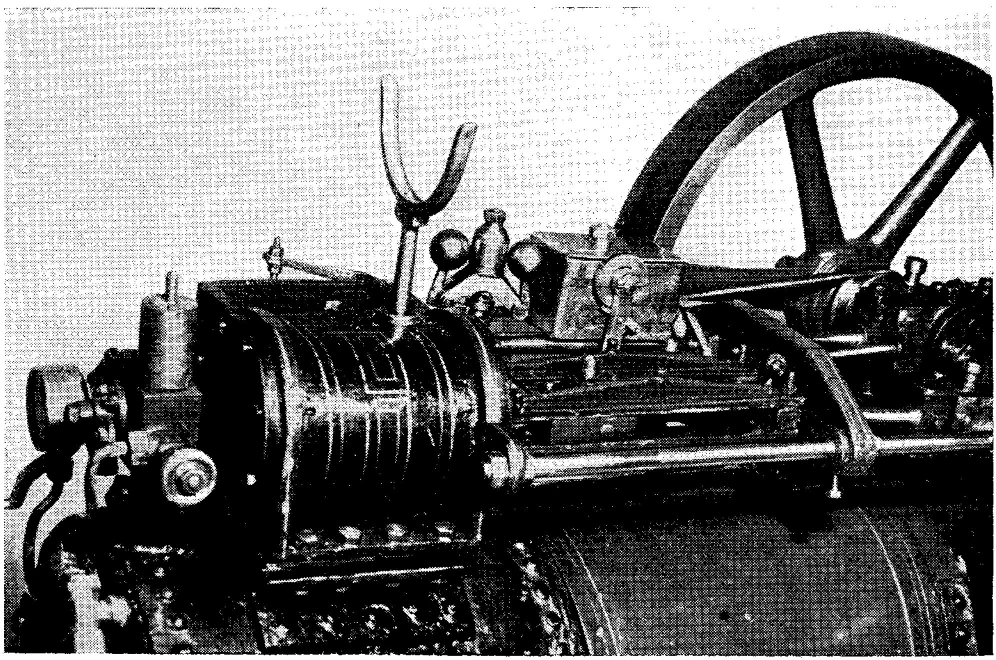


Photo No. 3. The other side of " the works," showing mechanical lubricator, governor and valve, steam lead from regulator to valve-chest, regulator, safety-valve, and blower-valve



Photos by] *[Press Photo Agency*

Photo No. 4. In this view may be seen the cylinder-fixing ; slide-bars and crosshead, motion-plate, bearing stay, and mechanical lubricator

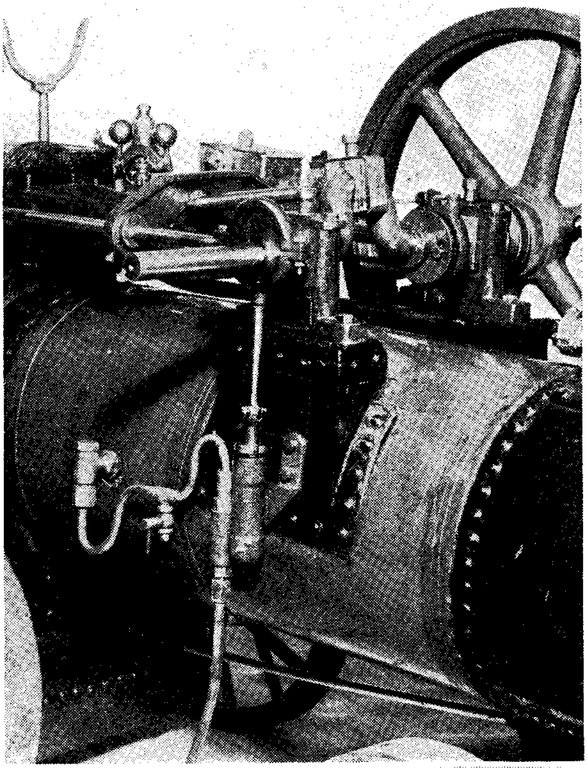


Photo by] [*Press Photo Agency*
Photo No. 5. Showing main bearings with brackets, pump, crankshaft " bent from the solid," eccentric and adjustment, and motion-plate

In addition, much information was obtained from Wansborough's *Portable Engines*. This was obtained from the local library, but many readers will doubtless be pleased (and surprised, as I was) to know that this book is *still in print*. I shall have more to say about this in a subsequent article, but meantime if anyone cares to know more, he should write to me—but *please* enclose a stamped addressed envelope.

Performance

In raising steam, the chimney is too wide to obtain a good draught, and therefore a $\frac{5}{8}$ in. diameter sleeve is dropped inside it until steam is raised.

After lighting the fire, it takes only a few minutes to raise 10 lb. on the clock, and then the engine can be started. In a few minutes more, the safety-valve is blowing off, and then all one needs to do is to keep a low fire on. As the builder puts it, " the boiler is too good ! " The working pressure is set to 45 p.s.i., which is ample for all ordinary purposes, though the boiler has been tested hydraulically to 260 p.s.i., and so could carry 80 or 90 with a very wide safety margin if need be.

The Workshop

In the workshop where she was built there is only moderate equipment, which includes a 4 in. Pools special lathe, a powered drilling-machine, a grinder, and a useful shaper, with the usual assortment of hand tools.

On a shelf I saw a partly-finished N.E.R. " 750 " (" L.B.S.C.'s " " Ten-to-Eight "), and a gas engine of $1\frac{1}{2}$ in. bore and $2\frac{1}{2}$ in. stroke, built about 30 years ago. It is interesting to note, by the way, that about this time Mr. Wilkinson built a governed vertical steam engine of 6 in. bore and 8 in. stroke (no *not* on the 4 in. lathe), which is still running.

Personally, I have no doubt that the portable too is capable of such longevity. She is robust, her working surfaces are large, and she works without effort. Certainly an engine to be proud of !

Since the above was written, this engine has run more than 350 hours under her own steam, including another four-day spell at our 1950 Exhibition.

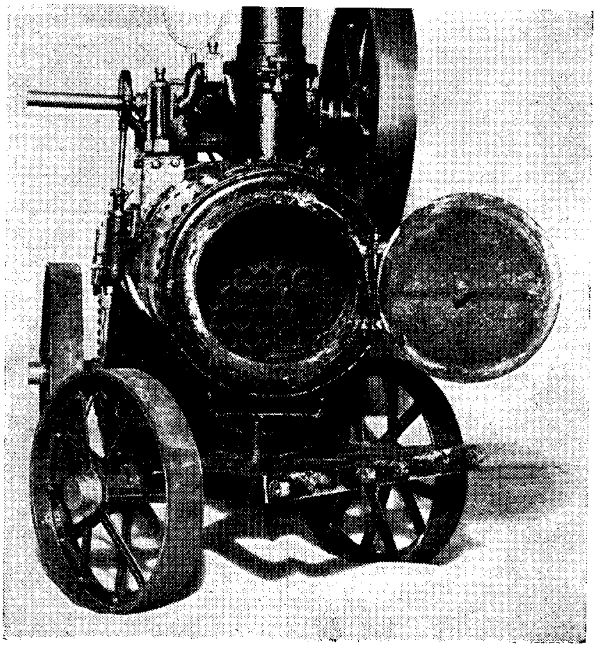


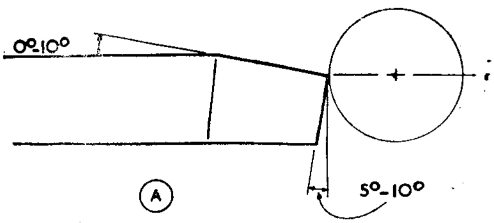
Photo by] [*Press Photo Agency*
Photo No. 6. Ready for cleaning the flues ! Another impressive view of Mr. Wilkinson's portable engine

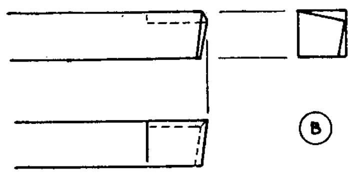
TURNING PLASTICS

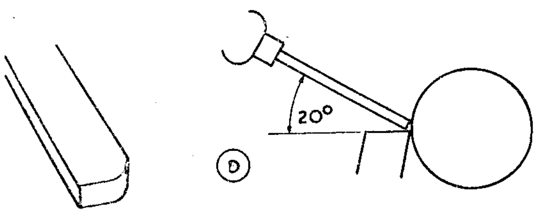
by P. W. Blandford

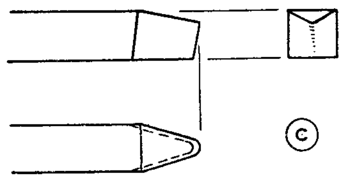
THERE are three main types of plastic likely to be of use to the model maker or amateur craftsman—cast phenolic resin (" Catalin "), acrylic resin (" Perspex "), and casein (" Erinoid " and " Lactoid "). The first is available in an enormous range of colours and in rods, tubes or special sections as well as sheets. " Perspex " may be coloured or clear, and is usually only easily obtainable in sheets, although rods are made. Casein is to be had as thin sheets and rods up to about 1 in. diameter in a variety of colours.

All of these plastics may be turned successfully and pleasantly with correctly-ground tools, but the turner who tackles them with tools ground to metal-working angles is in for trouble.





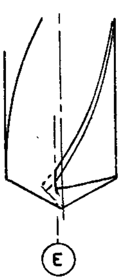




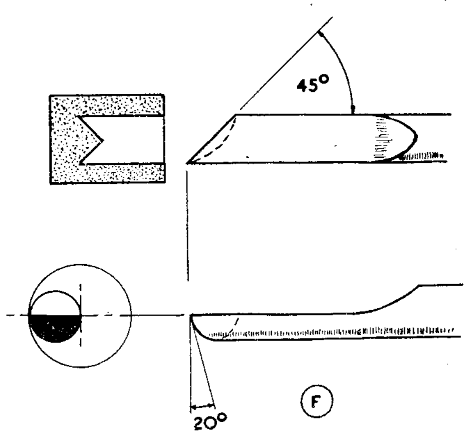
rake will also turn the other two plastics it is as well to adopt this as standard. (Sketch *A*.) A tool angle of 90 deg. does not make sense to the man used to metal or wood turning, and the best that might be expected is a scraping action, but in actual fact the swarf comes away in a smooth ribbon.

A right-hand knife tool (sketch *B*) will do most jobs, but a round-nosed tool (sketch *C*) has its uses. Parting in the lathe is not advised—it is safer to saw off. Although plastics are comparatively soft they need sharp tools. Like brass, they chatter and chip if tackled with a dull edge. Honing is worth while every time.

(*Continued on page* 585)



Cautious use of brass-turning tools is possible on plastics, but it is better to sharpen to the correct angles. Perspex and casein may be turned with flat-topped tools having only slight front clearance, but these may dig into Catalin, which prefers a negative rake. As a tool with a negative



"ALWAYS SOMETHING NEW"

by "Pat"

THESE notes, "Always Something New," are the result of trying to find substitutes for materials or new ways to make available materials answer the purpose. Very often the new way is superior to the old and we wonder why we did not use the new way originally. Thus in accordance with the spirit of the "Live Steamers" I pass these notes with the hope that they might help others.

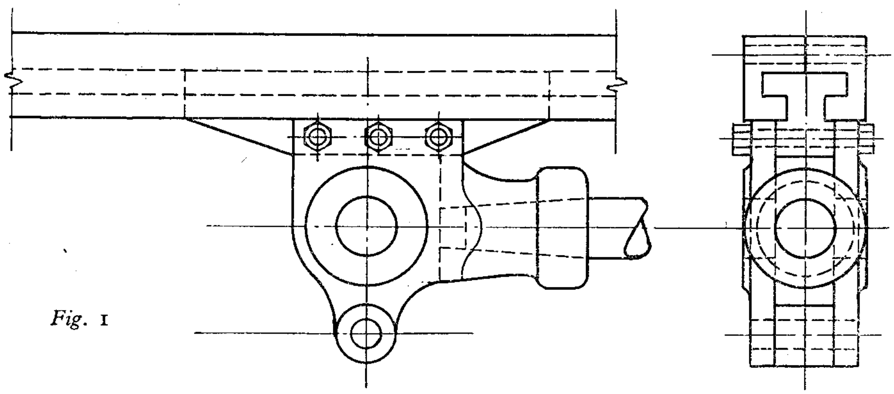


Fig. 1

Before the past war, the model engineer, or hobbyist, as some prefer to call him, found it rather easy to procure the castings used in his work. He could obtain castings at a variety of hobby supply houses, or at a local foundry from his own patterns. We all know that it was next to impossible to get any materials during the war as all materials were used to speed the war effort. Many hobbyists put aside their model work and took on war-work in their home shops, and hoped for bigger and better adventures in the hobby land once materials would be available. Since the close of the war, however, many foundries have been faced with a heavy back-log of work for repairs and replacements brought about by the war-time speed of production. These conditions still leave the hobbyist little material and less time to supply his wants.

Fabricated Parts

A glance through some of the trade journals will show the average reader that castings are not the only things the builders of full-sized equipment are using today; welded fittings and fabricated parts of machinery are being used where a casting had been used not too long ago. In the field of locomotive construction, particularly in full sized practice, the oxygen-acetylene torch has come to play a very important part in cutting out the various components from steel bar or billet stock. Even the heavy frames for our locomotives are being cut from a solid slab of steel, not one at a time but in pairs, by using a special pantograph arrangement that traces out and cuts the frame from one master pattern. After these frames have been cut, they are annealed and then machined to size. Even locomotive cylinders and driving-wheel centres are being constructed by the welding process. Where welded construction is being used, the tests on such work are very exacting.

In one of the late editions, 1947, of the *Locomotive Cyclopedia*, more parts are described as being cut from rolled or forged billets. One part described there, struck the writer of these notes. It was a description of a crosshead for a heavy 4-8-4 type locomotive. It looked as if this were the answer to our difficulty in getting something without an intricate pattern for the job. On the full-sized job the body of the crosshead was torch-cut from a solid billet. As we could not do a torch-cutting job in the ¾ in. scale, we decided to cut the part from the solid. The good old hack-saw, lathe, milling machine and the shaper came in each for a share in the job. This was quite an undertaking but the result pleased all concerned.

"Slippers"

A suitable drawing, made twice full-size of the parts, was prepared and the work began. The scrap-box gave us the required pieces of steel, and offered some pieces of hard brass to be used as the slippers, as we called them. The drawings, Figs. 4, 5 and 6, show the most widely used crosshead, the first one we made. The assembled crosshead is shown on drawing, Fig. 4, while Fig. 5 and Fig. 6 show the details. The outline of the body was carefully marked out on the steel and a few cuts with the hack-saw removed some excess metal. The fitting for the piston-rod was turned first. The body was mounted in a four-jaw chuck on the lathe so that the centre mark of the piston-rod ran true. The outline was carefully turned to size. While the

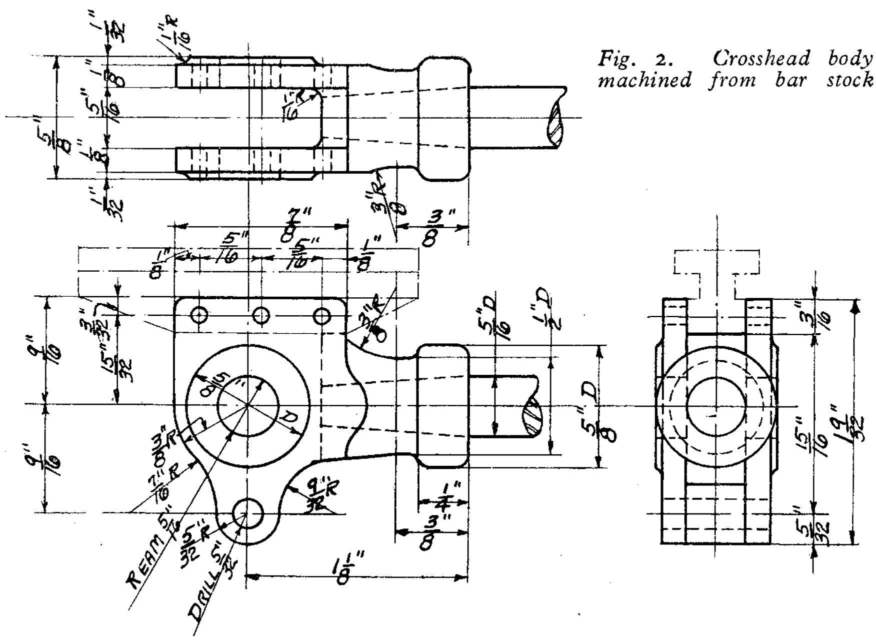


Fig. 2. Crosshead body machined from bar stock

piece was still in the chuck, the tapered hole for the piston-rod was drilled, bored and finally reamed with the special 8 deg. reamer made for the job. I soon found out that reaming steel was very different from reaming cast or malleable iron ; it took more time and a lot more cutting oil as the steel really was tough.

We were reasonably certain that the steel used was square and true so the next work was taken in stride. The wrist pin hole was then drilled and reamed. A small lathe mandrel was then pushed into the wrist pin hole and the two pieces were mounted between the centres of the lathe. With a lathe-dog driving the mandrel, both inner and outer faces of the body were turned to size.

In the work thus far accomplished, the marks we had made had become somewhat obscure, so they were checked and brightened up a bit for the really ticklish part of the job, cutting the openings for the slippers. These openings were milled out in the small milling-machine and brought to size for a close fit of the slippers. Resetting the body in the milling-machine, the

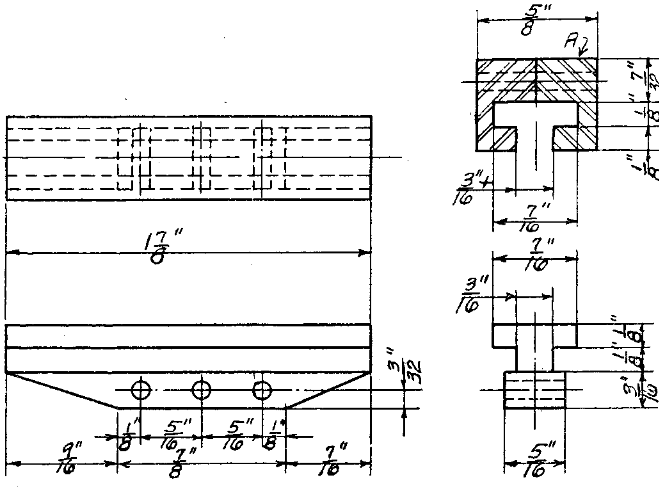
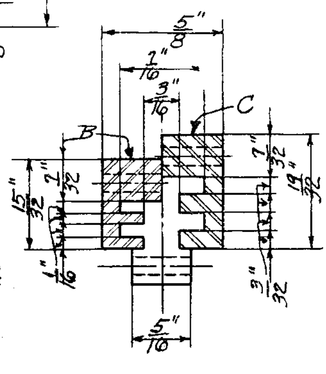


Fig. 3. Crosshead slipper, hard brass or steel. (One required per crosshead)



Closed guides

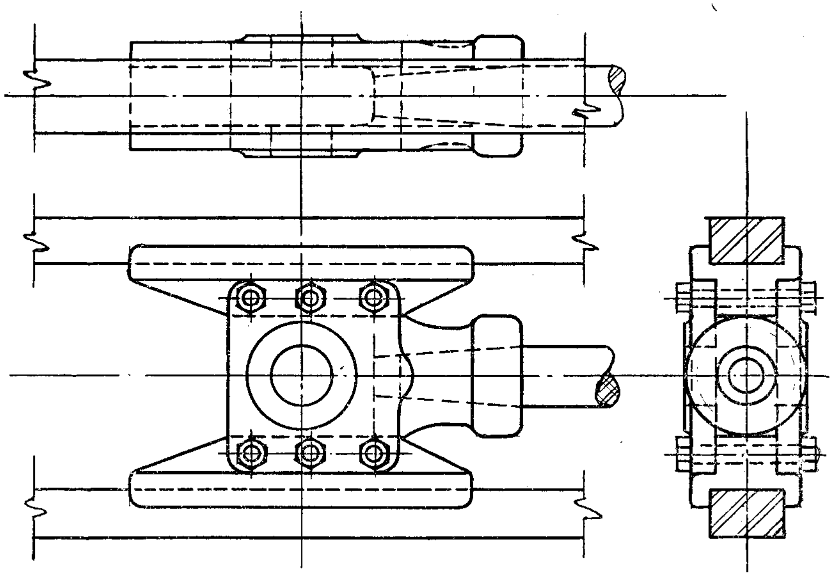


Fig. 4. Crosshead for $3\frac{1}{2}$-in. gauge locomotive. Machined from bar steel

slotted opening for the small end of the main rod was cut and finished. This ended the work on the body and all were pleased with the result, especially with the closeness to scale it showed.

The crosshead shoe or slipper, shown on drawing, Fig. 6, was cut from a piece of hard brass bar stock. After carefully marking out the side and end views, the piece was cut in two settings of the milling-machine. With a few passes of a heavy file, the radii on the ends and sides were cut and the whole piece was filed bright. The body and the two slippers were then jig-assembled, the necessary holes were drilled, and all was bolted in place.

The crosshead and slippers just described have been used on our big locomotives for years. On

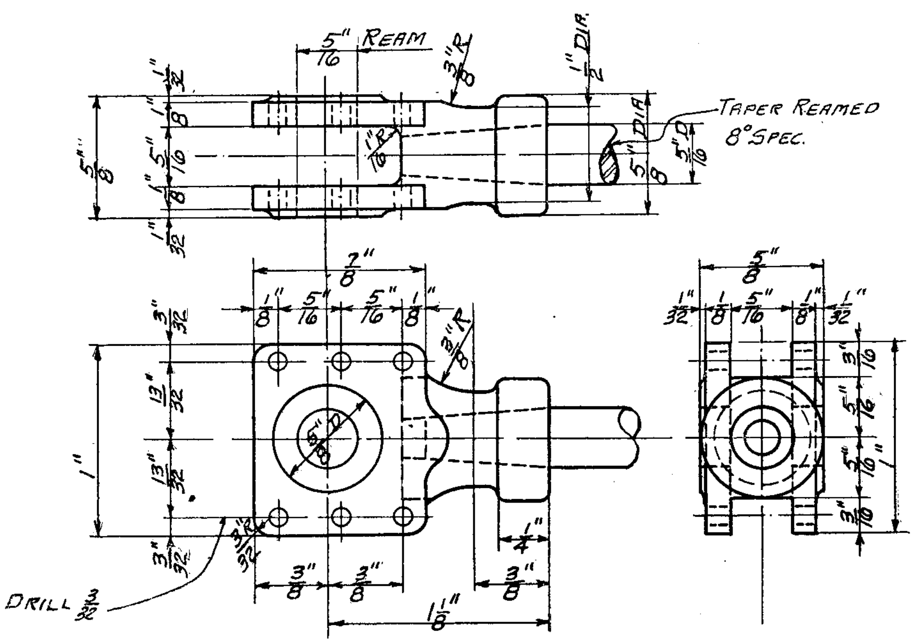


Fig. 5. Crosshead body, machined from bar stock

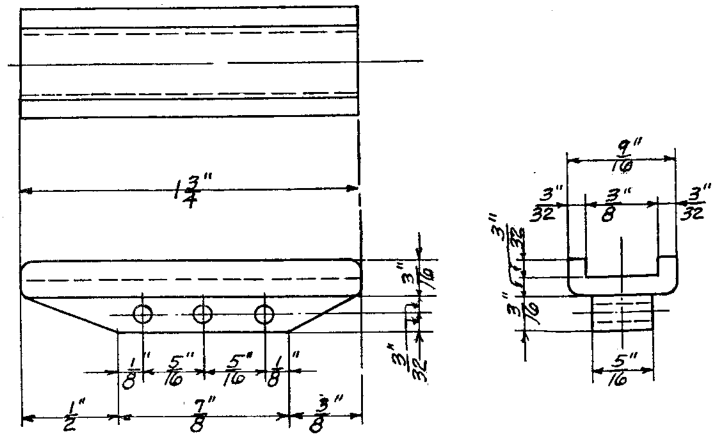


Fig. 6. *Crosshead slipper, hard brass or steel.* (*Two required per crosshead*)

many of the later locomotives, the enclosed type of crossheads and guides is being used more and more. An adaptation of this type is shown on drawings, Figs. 1, 2, and 3. Again all parts were cut from bar stock. There is a little more work in making this type as well as its guide. While the lower part of the body does not hold a slipper, it was thought better to use the lower part to hold the pin to which the combination-lever of the valve-gear is attached. The slipper shown agrees closely with that used on the cast crossheads. It is shown at *A*. It was thought that guide *B* and its corresponding slipper could be used to advantage, since it had more bearing surface and should wear better than *A*. The guide *C* is a bit huskier than *A* or *B*, but is a bit on the big side as far as the scale dimensions would allow. The guides themselves are milled from bar steel. In making the guides it was found better to select the bars long enough to make a pair of guides from each bar and then cut them in two when the grooves for the crosshead had been milled.

The methods of making the crossheads and their guides may seem a bit on the hard way of doing things, but we are certain that anyone can make the set of crossheads and guides that will certainly be without any hidden faults due to material used. The machined parts are far stronger than any type of castings the same size could be.

Perhaps, in the not too distant future some metallurgist will discover ways and means to make these small castings that really will stand up to their work, as something new is turning up almost every day in this modern age.

TURNING PLASTICS

(*Continued from page* 581)

There is plenty of scope for hand turning. Knobs and handles may be quickly fashioned in this way. I do most of my hand turning with a single tool, made from a ½-in. wood chisel, with its edge ground square across and with one corner rounded (sketch *D*). This is used on a T-rest set at centre height. The correct angle at which the smooth ribbons are produced is found by experiment on the first cut, but is about 20 deg. to the horizontal. This tool may be used either way up and normally has the rounded corner leading, except when working into an angle. I have even used the end of a 12 in. rule as a hand turning tool.

High Polish

The tool finish from honed tools should be quite smooth. This is the first step towards the high polish which is possible on plastics. The job may be further smoothed by holding a damp rag covered with pumice powder against it while revolving at the highest speed possible. This finish will probably be good enough for many purposes. For the brightest gloss remove from the lathe and polish on a mop with Canning's " White Gloss." If this is not available continue in the lathe using liquid metal polish on a pieec of cotton wool, or in the case of Perspex with the maker's " Perspex No. 2 Polish."

Boring Plastics

Plastics may be bored with tools having a negative rake. Normal twist drills tend to pull into the plastic with the consequent risk of cracking. Special plastic drills with steeper flutes are obtainable, but the ordinary twist drills may be modified by grinding their lips to remove the rake (sketch *E*). For drilling and boring small holes in the lathe a form of D-bit is useful. When entered centrally it produces a hole of its own diameter, but when moved off-centre it will drill a hole with a diameter up to twice that of the drill (sketch *F*). In further cuts it can be used to bore out the hole to any diameter.

A Small Sensitive Drilling Machine

by Andrew Todd

THE following is a description of a small drilling machine which I have made. It was designed to be built on a 4-in. centre lathe with a gap bed, and its main object, was the drilling of model ship fittings, though it has proved invaluable for all types of work. It will drill straight and true holes at high speed up to its maximum capacity of $\frac{1}{8}$ in. at the centre of a 7 in. diameter circle, 7 in. from chuck to table, and $8\frac{1}{2}$ in. from chuck to base. No castings were used, as they were unobtainable at the time the machine was built. All the material was bought at the local blacksmiths.

The Column. Part No. 1.

This was a 13 in. length of silver-steel $\frac{3}{4}$ in. diameter. One end was trued up in the four-jaw chuck, and the other end supported in a steady. It was then turned down to $\frac{5}{8}$ in. diameter for a length of $1\frac{3}{8}$ in. and screw cut $\frac{5}{8}$ in. B.S.F. for $\frac{3}{4}$ in. The bar was reversed in the chuck and the other end faced off and a small chamfer machined on the corner.

Baseplate. Part No. 2.

This was made from a slab of black mild-steel, 5 in. wide by 9 in. long by $\frac{3}{4}$ in. thick. I filed it up flat and scraped it true to a surface-plate. The edges were squared and the holes marked out. Tapped holes were put in to hold down the work, as I had no means of milling T-slots in the base. These holes were drilled right through the base, thus making them easily cleaned; they were tapped $\frac{1}{4}$-in. Whitworth. The hole for the column was bored by a boring bar between centres, the plate being clamped to an angle-plate mounted on the saddle. It was made a tight push fit for the column, which is held in place by a $\frac{5}{8}$-in. B.S.F. nut (Part No. 4).

Feet. Part No. 3

The machine can be screwed down to a bench if required, but I found that it was heavy enough to sit on the bench without being secured in any way. To keep the holes in the base clean I fitted feet made from 1-in. diameter B.M.S. bar. These were located by $\frac{1}{4}$-in. diameter Whitworth screws $1\frac{1}{8}$ in. long. If it is desired to screw the machine down to the bench, drill holes in the corner right through and countersink them on top. Use the feet as packing-pieces to keep the base clear of the bench.

Top and Bottom Arms. Parts No. 5 and 6

These were cut from a length of 1-in. square B.M.S. bar. They were mounted on the face-plate and the holes for the column bored and lapped to fit the column. A plug was made to fit this hole, and it was mounted on the faceplate at a radius of $3\frac{7}{8}$ in. from the centre, this being the maximum I could swing in the lathe. The bottom arm was mounted on the plug and set true and clamped to the faceplate, then the hole for the table spindle was bored and lapped to size. The arm was removed without altering the setting of the plug, the top arm was mounted in a similar manner and the hole for the spindle bush bored. The holes for the clamping-screws were also drilled by mounting the arms on the faceplate. As these holes break out into the others, care must be taken. I drilled them with a small drill first and opened them out with a boring tool, and finished them with a reamer.

I should have said that the lapping of the holes for the column was carried out after the holes for the clamping-screws were bored.

Two $\frac{1}{4}$-in. B.S.F. holes were drilled and tapped in the top arm for the fulcrum and spring. The taper sides of the arm were machined by mounting it in the four-jaw chuck and facing the surplus metal away. The ends of the bottom arm were filed up to a nice radius, as was the small end of the top arm. The rear end of the top arm must be made to suit the type of motor available. The drawings show the methods which I successfully adopted.

Table. Part No. 7.

The table was cut from a piece of mild-steel plate with an oxy-coal gas cutter. It is $\frac{3}{8}$ in. thick and $6\frac{1}{2}$ in. diameter. Both faces were machined in the lathe and the centre hole bored and screwed $\frac{3}{8}$ in. Gas.

Table Spindle. Part No. 8

Turned from a piece of B.M.S. bar 1 in. diameter, it was rough turned between centres and the thread cut to suit the table. It was then screwed tightly into the table, which was next mounted on the faceplate and the spindle turned and lapped to fit the bottom arm; the edge of the table was then turned true. A No. 12 hole was drilled right through the spindle for drill clearance. The top of the table was scraped flat to a surface-plate and frosted.

Table and Column Locking Gear

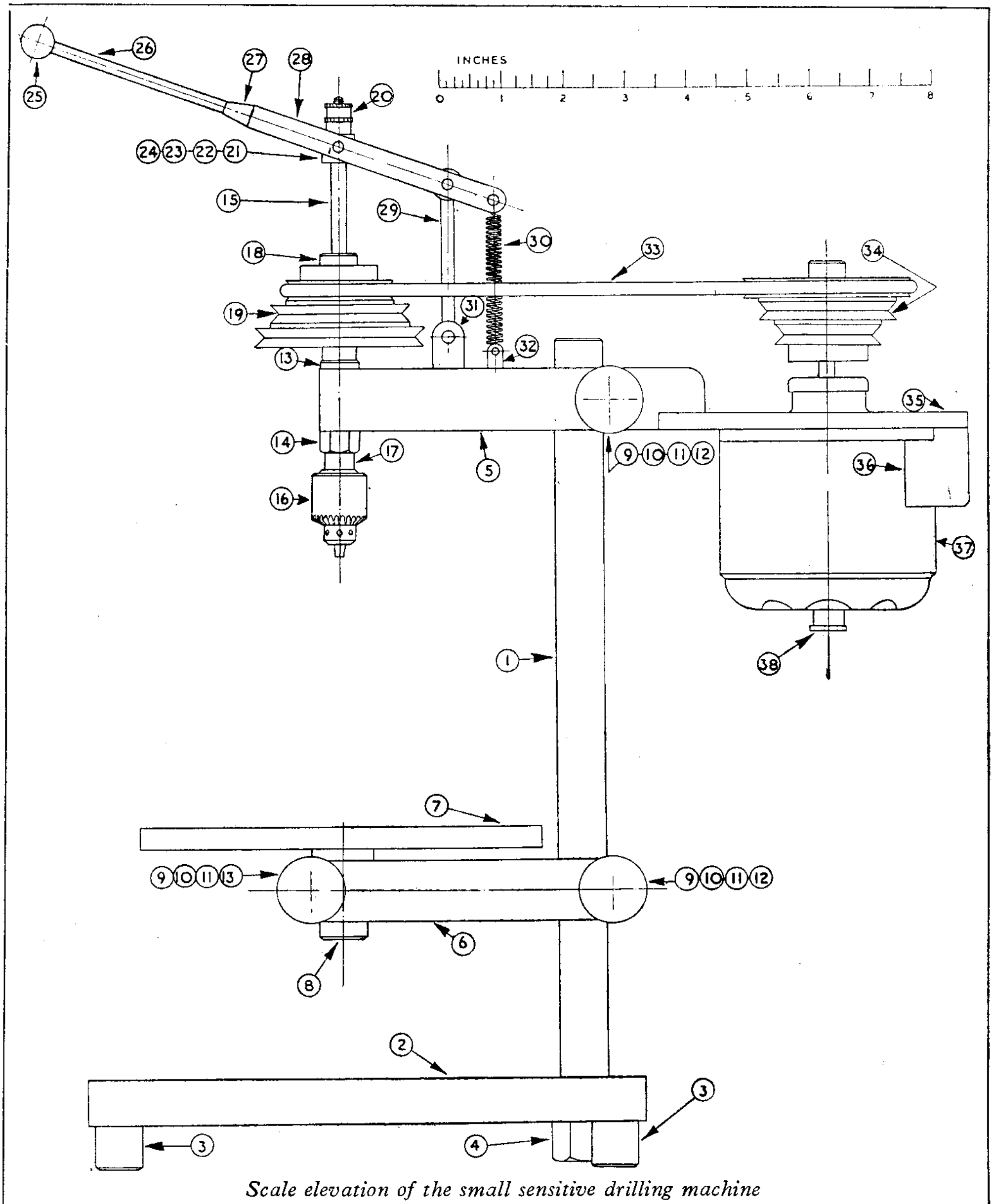
I strongly object to set-pins being used as locking devices on highly finished surfaces. In the locking gear shown on the drawings, a much more powerful locking force is obtained without bruising the spindle surfaces.

Locking Screws. Part No. 9

These were turned and screwed from $\frac{1}{2}$-in. B.M.S. bar. A small feather is fitted close up to the head of the screw to prevent the brass pad turning on it.

Locking Pads. Part No. 10

The pads were turned from $\frac{1}{2}$-in. brass bar.



Scale elevation of the small sensitive drilling machine

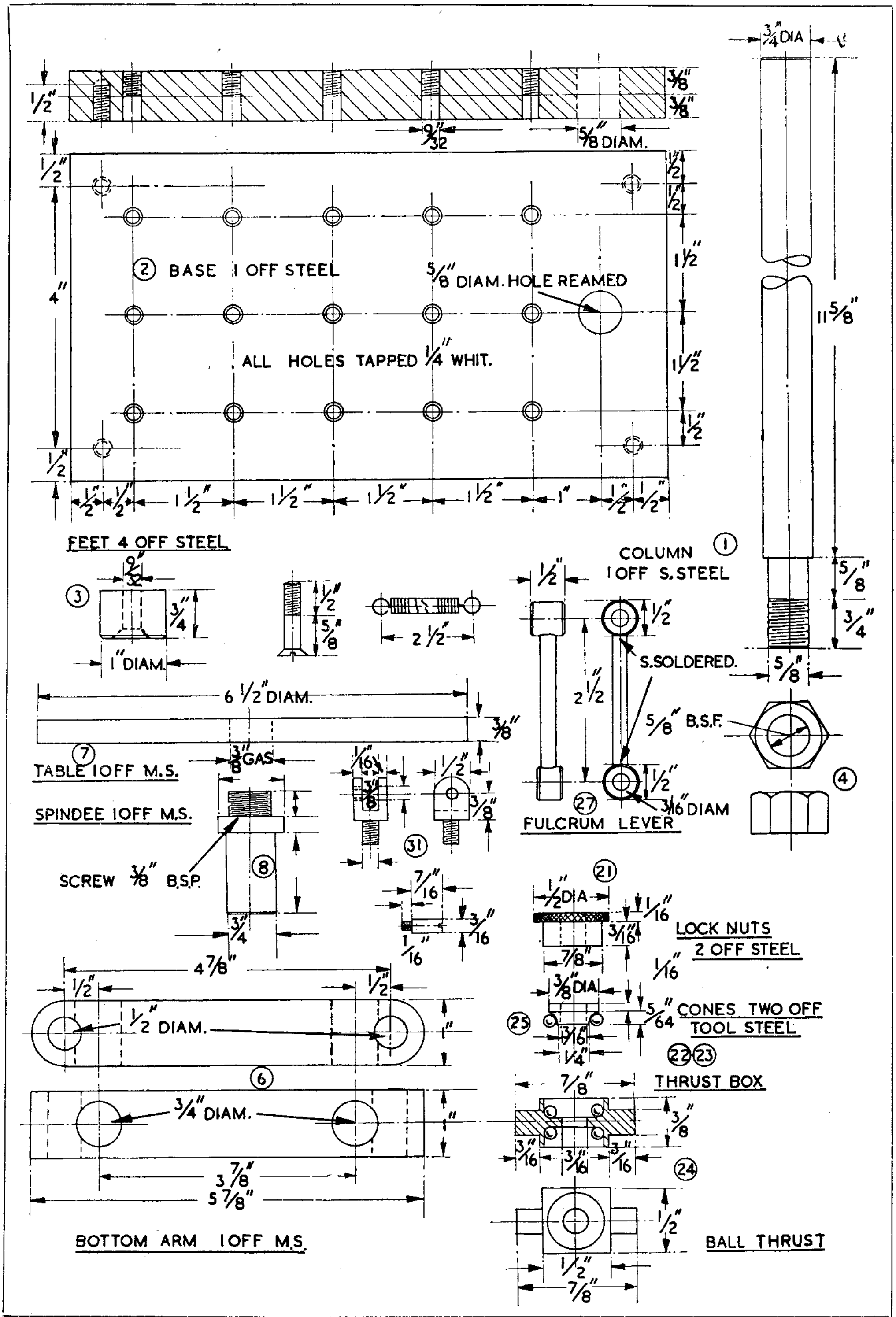
The bevel was filed on them and three off were slotted to fit over the feather on the screws.

Locking-Nuts. Parts No. 12-13

$1\frac{1}{8}$-in. diameter B.M.S. bar was used to make the nuts. The long one goes under the table, and it extends far enough through to be got at comfortably. The top and bottom arms and the locking gear were mounted on the column, which was lightly smeared with marking blue, the lock-nuts tightened gently while the arms were revolved on the column, then they were dismantled and the brass pads were bedded down to the column. Very little pressure is required to lock the arms securely.

Spindle Bush. Part No. 14

This is a simple turning job and it is made from a piece of $\frac{5}{8}$-in. diameter gunmetal bar. It should be a good fit in the top arm and is held in position by a nut tapped to fit the bush which is screwed $\frac{3}{8}$ in., 32 t.p.i.



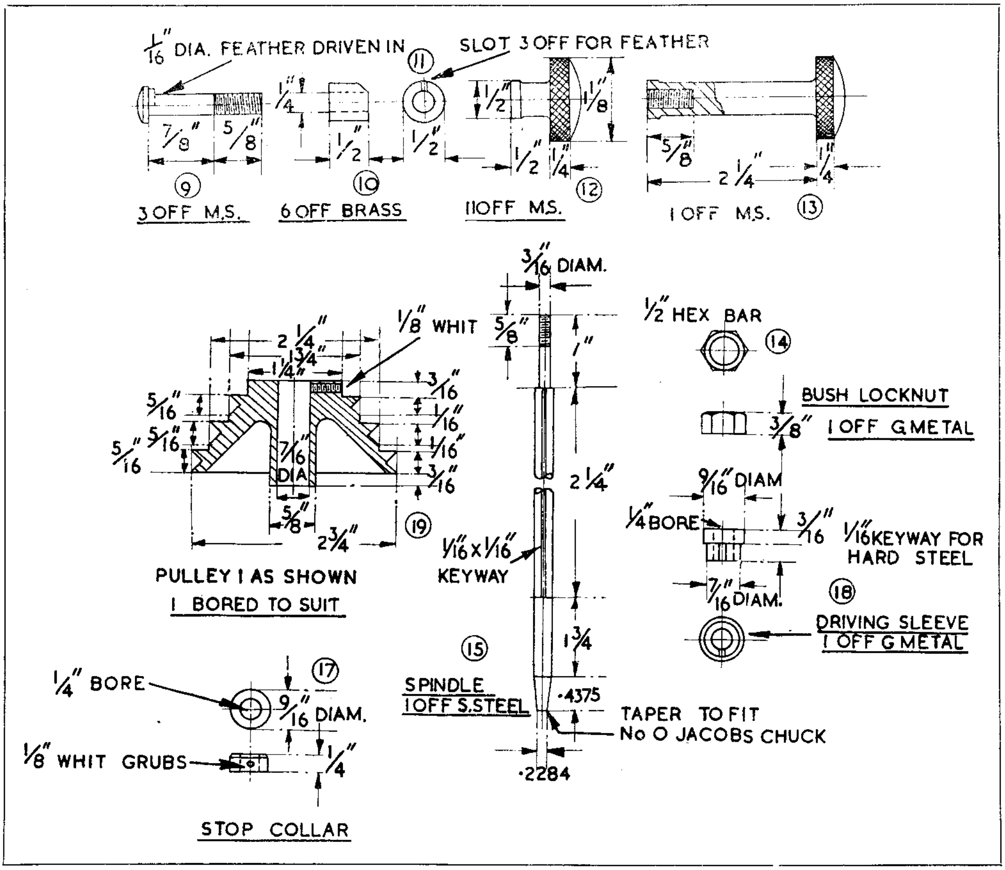
(2) BASE 1 OFF STEEL
5/8" DIAM. HOLE REAMED
ALL HOLES TAPPED 1/4" WHIT.
FEET 4 OFF STEEL
COLUMN (1) 1 OFF S. STEEL
TABLE 1 OFF M.S. (7)
6 1/2" DIAM.
SPINDEE 1 OFF M.S.
3/8" GAS
SCREW 3/8" B.S.P.
S. SOLDERED.
5/8" B.S.F.
3/16" DIAM
FULCRUM LEVER (27)
LOCK NUTS 2 OFF STEEL
CONES TWO OFF TOOL STEEL
THRUST BOX
BALL THRUST
1/2" DIAM.
3/4" DIAM.
BOTTOM ARM 1 OFF M.S.

Spindle. Part No. 15

The spindle is a piece of $\frac{1}{4}$-in. diameter silver-steel. It was carefully trued up in the four-jaw chuck and the end turned down to size and screwed 40 t.p.i. It was next reversed in the chuck, and the end turned to fit the taper on the chuck. The keyway was milled in the spindle, bar, and fitted with a $\frac{1}{8}$-in. Whitworth grub-screw, the end of which is dimpled into the spindle.

Pulleys. Part No. 19

The pulleys on my machine were originally part of a small countershaft as used by watch-



using a Woodruff cutter. The spindle was set up in the vertical slide during this operation.

The keyway is $\frac{1}{16}$ in wide $\times$ $\frac{1}{16}$ in. deep and is left unhardened. When using silver-steel, make sure it has a ground finish. Some of it is rolled and beautifully finished, but when the surface is broken it warps terribly.

Chuck. Part No. 16

This is the smallest size of chuck made by the firm of Jacob's. It is a lovely little job, and cost 19s. at the beginning of the war.

Collar. Part No. 17

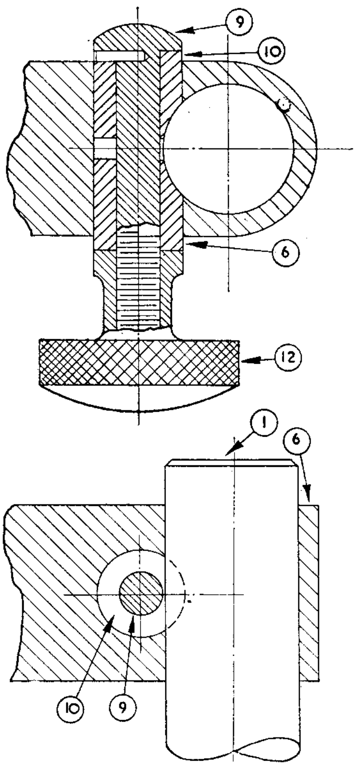
This collar is fitted immediately above the chuck on the spindle. Its purpose is to limit the upward travel of the spindle, thus preventing the bottom of the bush striking the spindle of the chuck. It is made from a piece of B.M.S. makers. I only altered the bores to suit my job and drilled the grub-screw holes. Mine are cast-iron, but aluminium alloy would be better. The machine should run at a very high speed and if the pulleys are a little out of truth, the vibration will be terrible. The pulleys should be turned all over at the one setting and bored, and finally parted off the bar. This ensures that all the faces are true with each other, and no trouble should be experienced with vibration.

The pulley should be a nice fit on the bush and a very light oil should be used for lubrication. To prevent the pulley rising in the bush, two small set-pins are fitted which project through the pulley into the groove turned in the bush.

Driving Sleeve. Part No. 18

In this machine all the pull of the belt is taken on the outside of the bush and not on the spindle.

To transmit the drive from the pulley to the spindle, the driving sleeve is used. This is made in gunmetal and should be a good fit in the pulley. A $\frac{1}{16}$-in. slot is cut through one side of the small diameter and into this is fitted a steel feather. The feather should be a tight fit in the sleeve and the sleeve and feather should slide without shake or bind on the spindle. The sleeve is held in the pulley by two $\frac{1}{8}$-in. grub-screws. On final assembly, it is impossible for the feather to drop out. This machine has been in use for almost 7 years now and has given no trouble of any kind.



Details of the locking gear

Thrust Box

A double thrust ball-race is used to transmit pressure of the lever to the spindle. It was originally intended to harden these parts after they had been run in, as no wear ever developed it was decided to leave well alone.

Thrust Block. Part No. 24

This was made from a piece of $\frac{1}{2}$-in. square silver-steel. A short piece was held in the four-jaw chuck and the two projecting pins turned in at the one setting and parted off. It was then rechucked and faced down to $\frac{3}{8}$ in. thick. The hole for the spindle was drilled and carefully opened out to form the ball track. To get the opposite ball track true with the first one, a stub mandrel was made, and the ball track pressed into it. The other ball track was then machined out to size. It is worth while taking a lot of care with this part.

Cones. Part No. 22

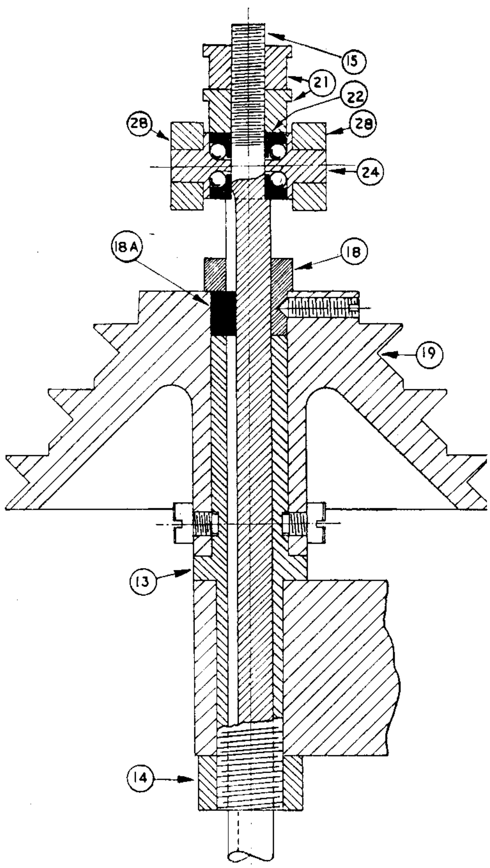
These were parted off a piece of $\frac{3}{8}$-in. diameter silver-steel. Care being taken to get as good a finish as possible on the ball surfaces.

Balls

I cannot remember how many balls were used in the thrust, but they are of 3/32 in. diameter.

Lock-Nuts. Part No. 21

The threads should be a good fit on the spindle, and all faces should be square with the bores; $\frac{1}{2}$-in. diameter B.M.S. bar was used to make them. They are knurled to get a grip for tightening purposes.



Section of spindle assembly

This completes the thrust box and it can now be assembled on the spindle. It should run freely, but no end shake is permissible, otherwise the smaller size drills are liable to be broken.

Lever Assembly

The lever is built up from mild-steel bar ; it is important that it be built up rigid and square.

Side Levers. Part No. 28

Two pieces of $\frac{3}{8}$-in. × $\frac{3}{16}$-in. mild-steel were clamped together to make these parts. All the holes being drilled from the one side to ensure that they were in line with each other.

Distance-Piece. Part No. 27

This was turned from a piece of $\frac{3}{8}$-in. × $\frac{1}{2}$-in. mild-steel. The side lever was clamped to it and the hole centres marked by the point of a drill. It was then set up square, and the holes drilled right through.

Part No. 26

This is just a piece of $\frac{3}{16}$ in. diameter mild-steel bar threaded at each end.

Knob. Part No. 25

I softened a steel ball to make mine, but it could be made from any of the plastics that are now on the market.

Screws

4-B.A. screws were used to hold the lever together. The link-pin was a piece of silver-steel, $\frac{3}{16}$ in. diameter.

Fulcrum Link. Part No. 21

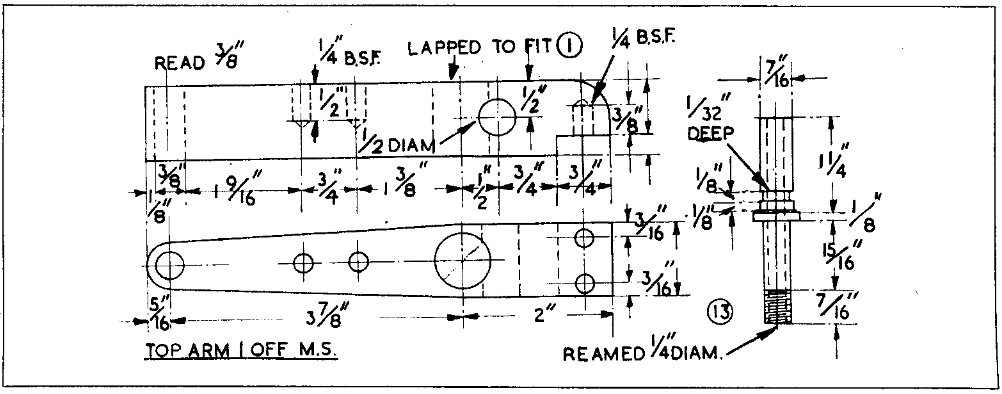
The eyes were turned from $\frac{1}{2}$-in. diameter. B.M.S. bar. The holes were reamed to size. A hole is drilled and tapped 40 t.p.i. in the side of the eyes. The connecting-rod is a piece of $\frac{3}{16}$ in. diameter silver-steel, screwed at each end to fit the eyes and were silver-soldered in place.

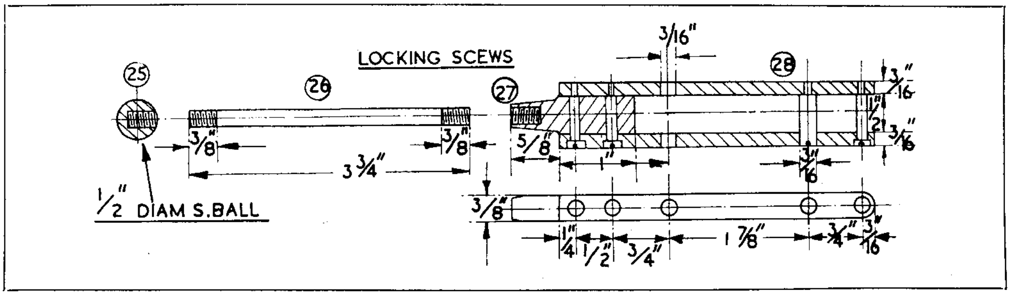
Bottom Pivot. Part No. 31

$\frac{1}{2}$-in. B.M.S. bar was used to make this part. The pin is a piece of silver-steel.

Spring Anchor

Made in a similar manner to the last piece, $\frac{1}{4}$-in. square steel is used.





Spring

The spring I used was a Meccano one, and was just a nice weight. It should be the lightest one you can get to do the job, as if it is too strong you will loose the feel of the drill when it is cutting. I have not shown in detail the brackets carrying the motor, as this will depend on the type obtained. I would suggest that a $\frac{1}{8}$-h.p. motor running at 5,000 r.p.m. is required. As most of these small high-speed motors are fitted with brushes, a suppressor may have to be fitted to cut out interference with wireless sets in the district.

I found the making of this machine an interesting job, and it has made the drilling of small holes a pleasure instead of a nightmare.

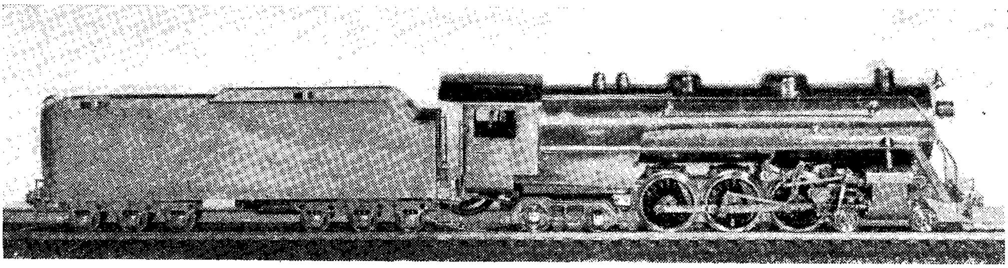
A Fine Piece of "Watchmaking"

by "L.B.S.C."

THE very fact that I just hate doing fiddling weeny jobs myself, makes me honestly admire the efforts of those good folk who just delight in them, and have the necessary skill and patience to carry them through; so I offer my sincerest congratulations to a brother of our locomotive craft who hails from the Middle West, to wit, Elmwood Park, Illinois, U.S.A. Our good friend Ernie Stalder says that when he started the locomotive illustrated, way back in 1942, he was very green in this particular field, and had never heard of the Brotherhood of Live Steamers, or your humble servant. However, he got hold of some copies of an American journal, in which an "O"-gauge "live steamer" (of sorts) was being described, and started on the chassis. Then through that same journal, he got to know about the Brotherhood of Live Steamers; and when now and again, somebody wrote enthusiastically about a certain "L.B.S.C." he wondered who on earth that party could be. Anyway, he wanted information about a coal-fired boiler for his engine, and wrote to the journal about it. They published his letter, and that did the trick. He received a reply from Alder Milburn, who—as followers of these notes don't need reminding—is building the "cut-from-the-solid" Atlantic engine. Al soon put friend Stalder wise, as to where he could get all the information he needed, for locomotive boilers, or anything else in that line; and gave him some details of the performances of his 4-8-4 *Lucy Anna* which I described in an old American journal now merged with another.

Brother Ernie didn't waste any time in getting the drawings of the *Lucy Anna* boiler, and by their aid he built a boiler for his own engine. It has a barrel and wrapper made from 9 in. of 2-in. copper tube. The combined length of firebox and combustion chamber is $4\frac{1}{2}$ in. all in. The barrel contains five $\frac{5}{16}$-in. tubes and a $\frac{1}{2}$-in. superheater flue, all $4\frac{1}{2}$ in. long; and there are two $\frac{3}{16}$-in. syphon tubes in the firebox, which is $1\frac{3}{4}$ in. wide and $2\frac{3}{4}$ in. long. Working pressure is 90 lb. easily maintained.

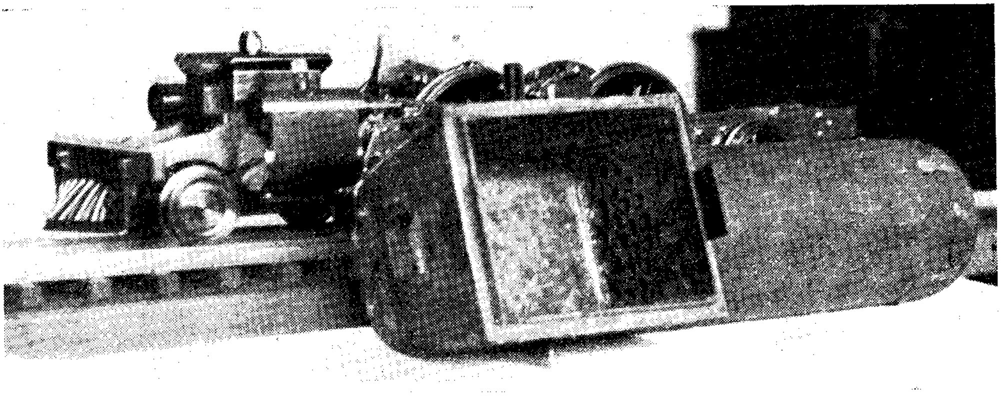
The cylinders are of cast iron, $\frac{7}{16}$-in. bore and $\frac{5}{8}$-in. stroke, with corrosion-proof pistons having two rings on each; the slide-valves are of bronze, actuated by full Walschaerts gear, a perfect "watchmaking job" in itself. Guide-bars and crossheads are similar to the Laird pattern. The driving wheels are $1\frac{1}{2}$ in. diameter *and have stainless steel tyres properly shrunk on*, a fact worth noting, as this job was done some eight years ago. The other wheels are all turned from solid rustless steel bar; in fact, most of the other parts are made of the same material, including the cleading plates of the boiler, the thickness of which is 0.008 in. The use of this metal is quite in order for such a little engine, which probably spends much more time standing idle than a much larger one would. Non-rusting material is used for those parts not made of rustless steel, the domes being turned from Monel metal bar, and the connecting-rods, coupling-rods and motion work are all in nickel-silver.



The little—but good!

Although the engine is finished off as a show piece, she works as well as she looks. The cylinders are oiled by a displacement lubricator under the smokebox, whilst the boiler gets its supply of water from a hand pump in the tender. She will run on coal all right, but anybody used to American steam coal, knows one of its disadvantages (followers of these notes should have seen old *Ayesha* on American steam coal; she put up a smoke barrage all over the landscape. At the New York Exhibition, in 1929, where she did the lion's share of the live passenger hauling, we had to use Ford briquettes, or she would have gassed everybody in the hall) so for cleanliness and convenience, friend Stalder fitted a spirit burner, and then had to plug up one-third of the wick tubes because she made too much steam. He says that once she's hot, all she needs in the firebox is a candle! That is what it seems like, anyway.

After the successful completion of the little engine, our worthy friend thought he would have a shot at something bigger, so chose a $3\frac{1}{2}$-in. gauge Atlantic locomotive of the usual American pattern, and the other pictures show the progress made



A " Maisie " boiler (original design)

to date. The cylinders for this engine are exactly to the instructions I gave for the cylinders for *Doris*, in the issue of July 8th, 1948. When they were finished and erected, friend Stalder, who had now made the acquaintance of John Matthews of Chicago—who needs no introduction to our older readers—invited John to come along and test them, which he did, with his stationary boiler; and they were both very pleased with their performance.

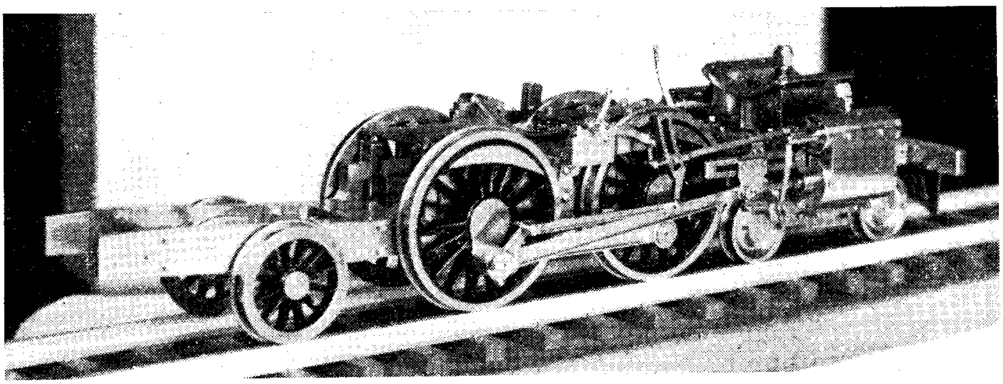
The boiler for this engine has just been finished. It is similar to the first one which I described for the original *Maisie*, but is $5\frac{1}{2}$ in. diameter, and has 19 $\frac{1}{2}$-in. tubes and two $\frac{7}{8}$-in. superheater flues in it. Our friend is just getting nicely steamed up himself, to get the engine on the road, and is going to make one of my injectors for it. Here's wishing it all success, and hoping for some pictures of the finished job, and a report on how she " does the doings."

A Stationary Boiler for Testing

Mention of Bro. John Matthews' stationary test boiler above, reminds me that from time to time I receive requests for a drawing of a fast-steaming stationary boiler, suitable for testing a chassis, trying injectors, or doing any other job needing a good supply of hot steam, including the driving of stationary steam engines, " utility " or ornamental. Therefore, by way of a " break," here is a response to the requests. The boiler is simple enough to make, will steam almost with the rapidity of a " flash " boiler, and incorporates my locomotive type of superheater. The following brief notes should enable the rawest of tyros to make the boiler without the least trouble.

The boiler shell is simply a piece of 5-in. diameter 16-gauge copper tube, squared off at each end to a length of 10 in. The firebox is a piece of $4\frac{3}{8}$ in. diameter seamless copper tube, squared off to a length of 4 in. If one end of each is held in the three-jaw, and a disc of wood put in the other end and supported by the tailstock centre, the squaring-off is easily done with a round-nose tool set in the rest, on an angle. Use a drop of cutting oil. When gripping the end of a tube in the chuck. I always jam an old wheel, or something similar, inside it, to prevent the chuck jaws crushing the tube, and distorting it.

Both the firebox crown, and the top tubeplate,



An American Atlantic chassis with " Doris " cylinder

are flanged up from 13-gauge copper, exactly as described for locomotive smokebox tubeplates, over circular iron formers; and the flanges are turned to a tight fit for the firebox and shell. Set out the tube holes in the smaller one, drill them No. 30, and use that plate as a jig to drill the larger one. Open out with 19/64-in. drill—except, of course, the centre flue, which is drilled 63/64 in. and reamed 1 in.—then ream $\frac{5}{16}$ in. and countersink the lot; those in the firebox plate on the flange side, and those in the top plate, on the side opposite flange. The 55 tubes are all $4\frac{7}{16}$ in. long, ditto the flue; and the whole lot can be silver-soldered into the firebox plate at one heating. Put them all in the tubeplate, letting them project through about $\frac{1}{16}$ in.; stand the assembly upside down in the brazing pan, with the tubeplate on top, the flange pointing upwards. Pile the coke or breeze all around, to the level of the tubeplate. Anoint the whole bunch of projecting ends with wet flux, powdered borax mixed to a paste with water, or "Easyflo" flux, or Boron compo. Drop some little squares of sheet silver-solder, or bits of "Easyflo" strip, all among the ends, and heat up the whole issue to a medium red, either with an air gas blowpipe, or a blowlamp. Don't use an oxy-acetylene outfit for this, as you might burn or melt the tubes. If you have distributed the bits of silver-solder evenly, and there are enough of them, the 55-plus-1 tube ends will all have a nice fillet around them without the slightest trouble. Pickle, wash off, and clean up the tubeplate flange.

How to Assemble the Firebox

The firehole ring is made exactly as described for locomotive boilers, being just a $\frac{1}{2}$-in. length of $1\frac{3}{8}$-in. by $\frac{1}{8}$-in. copper tube with a $\frac{1}{8}$-in. step, $\frac{1}{16}$ in. deep, turned at each end, leaving $\frac{1}{4}$ in. full diameter in the middle. Soften this after turning, squeeze it oval, and then bend to the curve of the firebox; the soft copper will bend easily enough—in fact, the confounded stuff bends when you don't want it to bend! Cut an oval hole in the firebox, centre of same being about $1\frac{1}{4}$ in. from the top, and poke one lip of the firehole ring through, flanging down the lip on the inside, same as a locomotive one. Clean around the inside of the top edge, and insert the tubeplate, making quite sure that the nest of tubes stands vertical. Stand the assembly in your brazing pan, pile up the coke to the level of top of firebox, and you'll find that with ordinary care and attention, you can silver-solder all around the joint without disturbing a solitary tube. Smear wet flux all around; heat the whole lot gradually, going all around with the flame; then when the coke begins to glow, concentrate on one place, keeping the flame off the tubes as much as possible. Apply the silver-solder in strip form; and as soon as a little melts and runs in, shift the flame a wee bit farther along, and run in some more. Make the operation kind of continuous right around. Warning: Don't apply the silver-solder until the copper is hot enough to melt it; that is the whole secret.

When the whole of the circumferential joint is done, lay the assembly on its side, with the firehole ring upwards; then silver-solder around the ring. Pickle, wash and clean off again, taking care to have the bottom edge of the firebox quite clean.

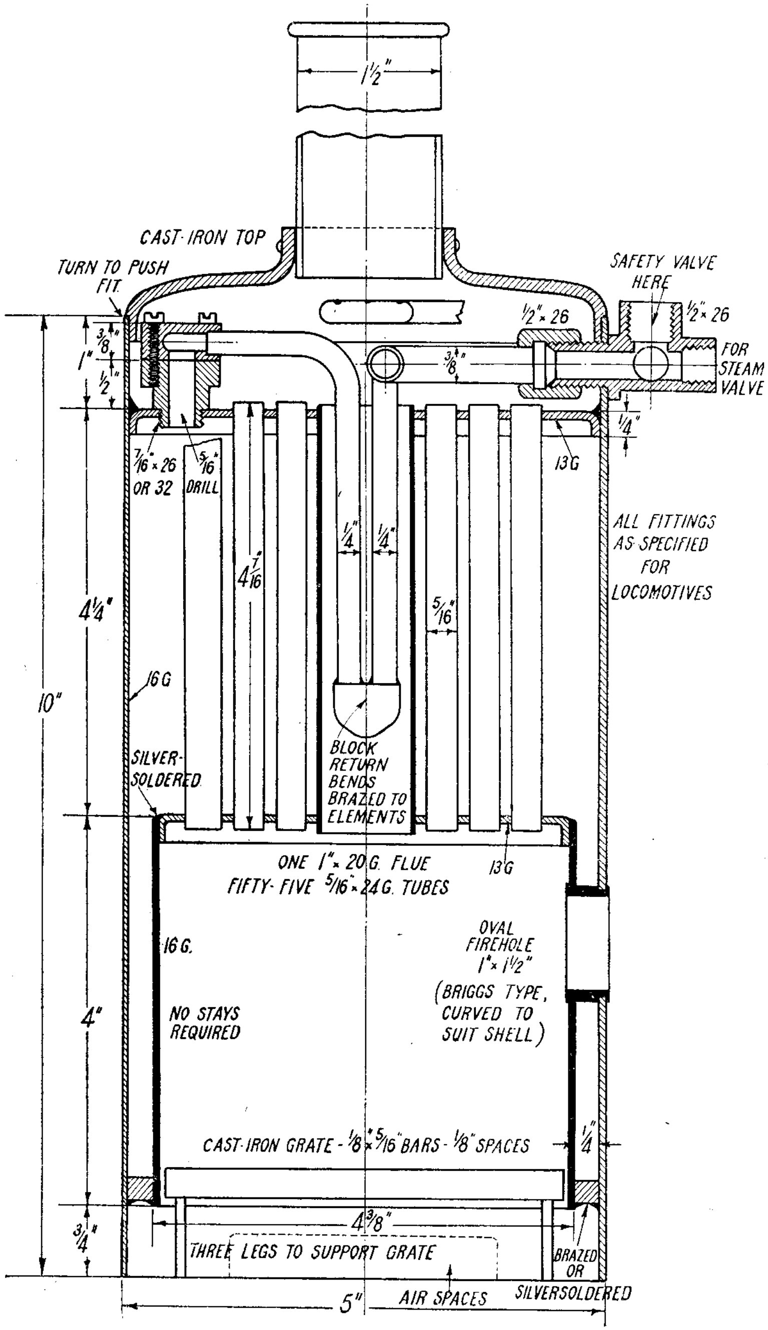
How to Fit Firebox and Tubes to the Shell

Cut an oval hole in the shell for the firehole ring, centre of same being $3\frac{1}{2}$ in. from the bottom. Around the bottom itself, cut away three segments about 3 in. long and $\frac{1}{2}$ in. wide, to let the air in when the boiler is standing up. Well clean the inside of the shell all around, $\frac{3}{4}$ in. from the bottom, and 1 in. from the top. Insert the firebox and tube assembly, put the outer lip of the firehole ring through the hole, from the inside, and beat it down flush outside, supporting the inside meanwhile, on a bar of iron held in bench vice and projecting from the side. The foundation ring on this boiler really *is* a ring, made from $\frac{1}{4}$-in. square copper rod; soften before bending, well clean it, and be sure the ends butt together without leaving any gap. Carefully drive it into the space between firebox and shell, leaving the firebox projecting about $\frac{1}{16}$ in. beyond the ring.

Next, insert the top plate, taking care that the blank space corresponds to the one on the firebox crown; easy enough, as there is no tube there. Drive the plate in until the tubes are almost touching it; then line them up with the holes, with a wooden skewer, pencil, or knitting needle. This job may try your patience! Finally drive the plate down until all the tubes are about $\frac{1}{16}$ in. through; then drill a $\frac{3}{8}$-in. hole in the middle of the blank space, also drill the holes for water-gauge and fittings to vent the boiler whilst finally silver-soldering. This procedure is practically the same as the final job on a locomotive boiler. About the best way to keep the job hot, when using a blowlamp or air-gas blowpipe, is to use a temporary brazing pan or tray with a 5-in. hole in it, putting the boiler about half way in, and piling coke right around the projecting part, up to the top. Do the foundation ring first, putting wet flux all around, and proceeding exactly as I have described fully for locomotive-type foundation rings. Give a preliminary heat up, concentrate on one spot, and work your way around. For blowlamp or ordinary blowpipe operation, best grade silver-solder, or "Easyflo," can be used. Inexperienced coppersmiths had better do top and bottom in two heatings; but our more experienced friends can quickly reverse the boiler when the ring is done, pile up the coke again, and fix the top plate and tubes whilst the boiler is still hot. If this is done, the whole lot should be fluxed before starting on the ring. Finally, lay the boiler on its side, firehole upwards, and do the outside flange of the firehole ring. Be careful how you put the boiler in the pickle, for the acid will blow out of the holes in the shell, in all directions, until the nest of tubes is quenched. Let it stay in about 20 min. or so, then fish it out and give it a thorough washing, inside and out. A handful of steel wool will give a splendid finish to the outside, with a little rubbing.

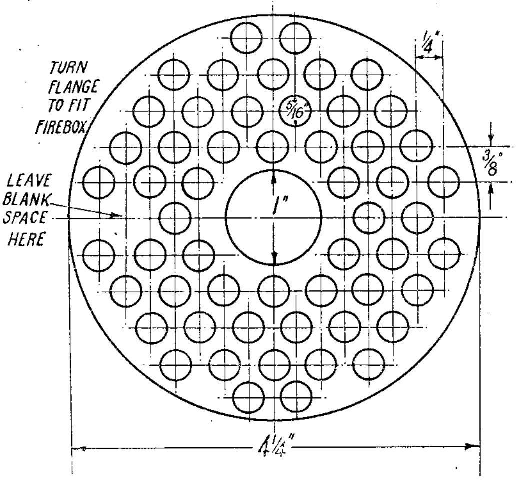
Smokebox Top and Chimney

The top is an iron casting. Our approved advertisers will be able to do the needful; they



Section of boiler

never hesitate about supplying castings to my recommendations, as there is always a good sale! The edge is turned to a fairly tight push-fit in the top of the shell; but not too tight, as it should be readily removable for cleaning purposes. The top is bored for the chimney, which is a piece of $1\frac{1}{2}$-in. tube of any desired length for attachment to the combination fitting which carries the steam valve, safety-valve, and any other fitting which builders may require to attach to it. The whole of the superheater joints may be silver-soldered, with the exception of the return bends which join the elements. These should be brazed with brass wire—it only means heating to bright red instead of medium—as they are exposed to the full benefit of the fire. However, the superheater is always full of steam, as the valves and other outlets are on the discharge side of it. The hot header is attached to the steam flange by three $\frac{1}{8}$-in. or 5-B.A. screws, as shown; a joint gasket of 1/64-in. Hallite, or any similar material, is placed between the faces.



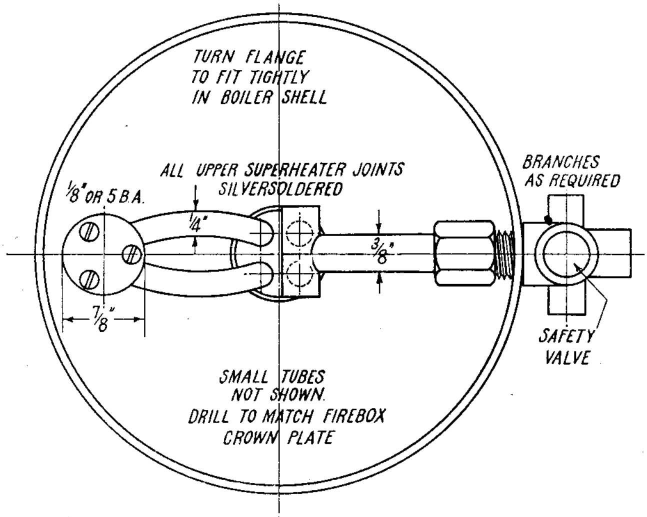
Firebox plate

A beading of half-round wire may be silver-soldered around the top of the tube, for sake of appearance, if you so desire. As there is no need to part the casting and chimney, put a few 3/32-in. iron rivets through the joint.

Fittings and Mountings

The main outlet is shown in the illustrations, and needs no detailed description, as it is merely a glorified tee, screwed through a tapped hole in the top of the boiler shell, and connected to the hot steam pipe by the union nut and cone already mentioned. The safety-valve may be one of my regular locomotive safety valves, though personally, being a bit old-fashioned in some things (especially age!), I would prefer the old weighted-lever valve, which was practically standard on stationary boilers in the heyday of steam, when all workshops, factories, mills and so on, were driven by steam engines of all sorts and sizes. *Milly Amp* does the job far more efficiently nowadays, and all credit to her for it; but, alas! she has taken all the interest out of the job. Flick the switch—a whirr, and away we go! Getting the big mill engine started up before the lads and lassies trooped in, was rather more of a job; but the interest was there, and it was a majestic sight to see one of these huge steam engines turning over at a "dignified" rate of speed, yet providing the power for hun-

(*Continued on page* 599)



Arrangement of superheater

Superheater

The superheater is exactly the same as the one I fitted to the rebuilt 2-8-2 *Cock-o'-the-North*, which proved very successful. It has two elements in one flue. The wet header is exactly the same as I have repeatedly described for locomotives, except that there is no internal steam pipe. The header and flange may be either turned from castings, or $\frac{7}{8}$-in. round rod; brass would do quite well, if nothing better is available, as there is no movement and no wear. Two steps are turned on the flange, as shown in the section, the smaller one being screwed $\frac{7}{16}$ in. by 26 or 32, to fit the tapped hole in the top plate. The header itself is $\frac{7}{8}$ in. diameter, $\frac{3}{8}$-in. thick, with a $\frac{5}{16}$-in. blind hole in the middle, and two communicating holes drilled in the edge, on an angle, to accommodate the two $\frac{1}{4}$-in. elements, which are curved to meet them.

The hot header is a 1-in. length of $\frac{3}{8}$-in. copper tube with a $\frac{1}{16}$-in. disc closing each end. The straight elements are fitted into two holes in the underside. A piece of $\frac{3}{8}$-in. copper tube is fitted to the side of the header tube (see plan view) and this terminates in a union nut and cone,

Novices' Corner

Looking after the Lathe and Preventing Wear

THE purchase price of a good lathe represents, in part, the manufacturing costs involved in attaining a high degree of accuracy in the finished machine; for example, the precision lathe, although usually of relatively simple design is very costly. Consequently, it is hardly wise to buy an expensive machine and then squander the worth of its good qualities by neglect or ill usage, for a well-made lathe, given proper attention, will retain its accuracy almost indefinitely.

The mandrel is one of the most important parts of the lathe, and on its accuracy will largely depend the quality of the work turned out; it is, however, a highly stressed component and, as such, demands not only regular lubrication but also timely adjustment. Whatever the form of the lubrication system of the mandrel bearings, it is important always to make sure that there is an ample supply of oil to these bearings when the machine is started. To save wear of the mandrel nose, both the threaded portion and the plain register should be wiped clean and re-oiled whenever the chuck is changed. Manufacturers supply instructions for adjusting the mandrel bearings and the thrust-bearing to take up wear; this matter should receive periodic attention, particularly when the lathe is new, for, if excessive slackness is allowed to develop, bearing adjustment may not then restore the original accuracy and proper fit of the bearings.

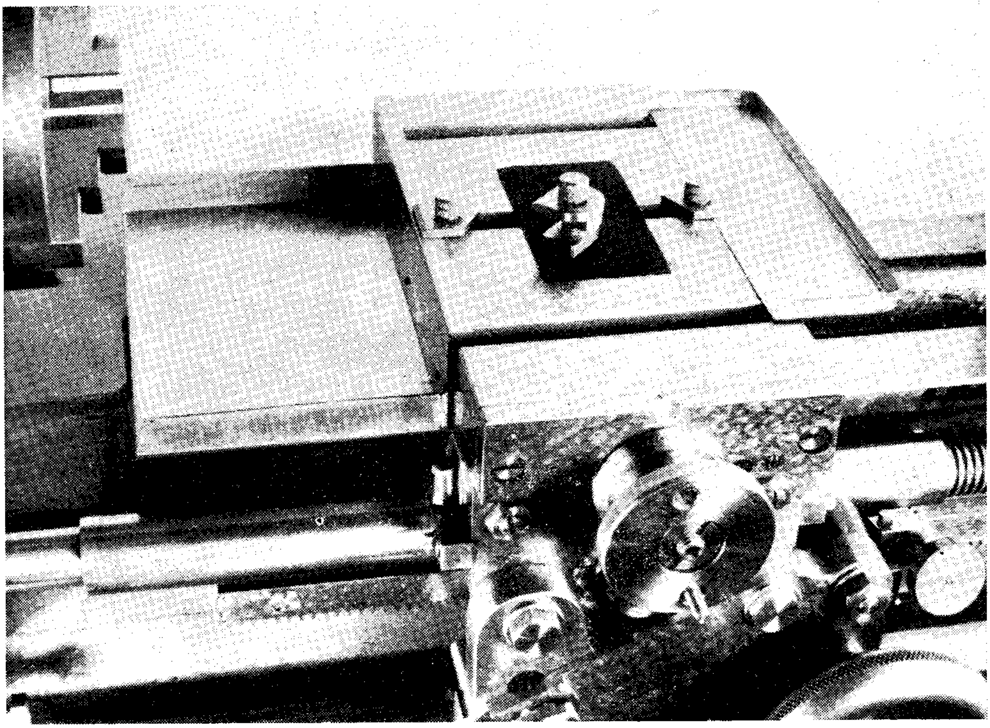


Fig. 1. Showing the two chip trays in place on the cross-slide and the leadscrew guards

The bearing surfaces of the lathe slides must also be kept clean and well lubricated. The gibs should be adjusted so that the slides move freely and without shake. Although the experienced worker can readily determine the correct adjustment by the feel of the slide movement, others may find it helpful to use the test indicator as a guide. For this purpose, the indicator is mounted on the slide with its contact point against some fixed part of the lathe; on twisting the slide with the hands, the indicator will reveal any slackness present. There must always be some play in the ordinary form of V-slide, but when the parts are accurately fitted this is very small.

It is a common fault to adjust the slides too tightly, for this will not increase the slide's accuracy of movement, but will certainly cause unnecessary wear in the feed mechanism if the slide is made stiff to operate. It must be remembered that the slides are designed so that the working thrust at most times falls on the solid "V" portion of the base casting, and the duty of the gib is then to keep the slide against this face. In some turning operations, however, such as boring, the thrust from the tool may be taken against the gib itself, and it is then usually advisable to clamp the slide by means of its locking-screws if these are fitted. The feedscrews operating the saddle and its slides are in constant use, and they and their nuts should, therefore, receive regular cleaning and oiling. At the same time, the thrust collars fitted to the feedscrews should be adjusted so that only a small amount of backlash is present.

Quite apart from the small amount of wear which inevitably takes place in all working parts, however well designed and cared for, there is another source of wear that is much more serious in its consequences. This is wear caused to the lathe slides and moving parts by the presence of

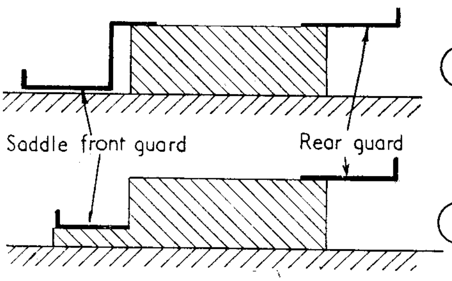


Fig. 2. Showing the position of the chip trays on the saddle

abrasive particles. A lathe manufacturer recently told us that, when reconditioning a lathe, 15 thousandths of an inch had to be ground off the upper surface of the bed to make good the wear present at the headstock end, and so restore the flatness of the bed shears. When grinding operations are carried out in the lathe, the abrasive dust formed will cause rapid wear if allowed to collect on the bed and slide surfaces, and to prevent this, the working parts of the lathe must be kept well covered. Examination of the special type of machine designed for commercial grinding will show how effectively all the working parts are protected, so that the machine can be used for long periods without suffering damage or needing overhaul. Another form of abrasive apt to cause lathe wear is the sand and scale deposited during turning operations on iron castings; it is advisable, therefore, to remove these substances by a pickling process before the castings are machined. Chips of alloy steels that are themselves harder than the metal of the lathe bed will also cause wear, and even cuttings of softer materials, becoming wedged in the slides, will give rise to wear by increasing the contact pressure between the slide surfaces. When fine chips are allowed to collect on the bed, some will find their way between the saddle and the bed slides as the saddle is moved to and fro; this, apart from any abrasive action there may be, will cause the saddle to move more stiffly at the headstock end of the bed, and increased wear in this situation will result.

The outcome of this is that the bed will become

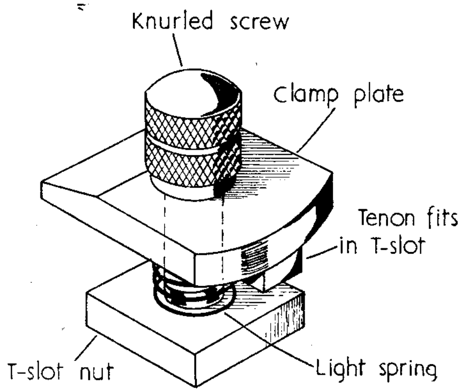


Fig. 3. Clamp used to attach the chip trays

worn out of parallel, and the saddle gib cannot then be adjusted to make the saddle fit correctly at the two ends of the bed.

It is worthwhile, therefore, taking trouble to prevent the entry of chips into the spaces between the slide surfaces.

For this purpose, felt wiper-pads are sometimes fitted to the lathe slides; these pads should be kept oiled so that they supply a film of lubricant to the slide-ways in addition to brushing away the chips. In time, however, the pads themselves become impregnated with fine chips which are

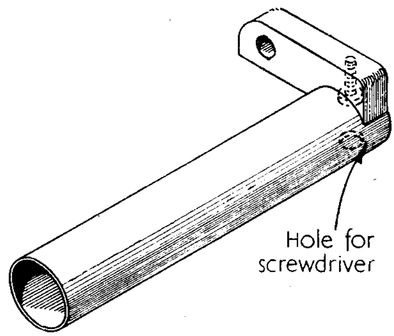


Fig. 4. Form of chip guard fitted to the forward end of the saddle

then distributed over the slide surfaces; it is advisable, therefore, to remove the pads from time to time so that they can be cleaned in petrol or even renewed. On the whole, it is perhaps best to keep the bed slides as far as possible free from chips by means of protective chip trays. The photograph, Fig. 1, shows two of these trays attached to the lathe cross-slide. The forward

tray will pass under the chuck and serves to collect most of the chips formed while turning or drilling, and at the same time the exposed end of the bed is fully protected. The tray on the right-hand side catches stray chips and prevents their falling on the bed immediately behind the saddle. The method of positioning the trays is shown diagrammatically in Fig. 2; *A* represents the application to a lathe of the Drummond type, and *B* shows the forward tray resting on the saddle wings.

As it is important for convenient working that the trays should be readily detachable, either for being emptied or for allowing the tailstock to be moved close to the saddle, they are held in place by means of small, finger-operated screw clamps. One of these clamps will be seen in Fig. 1 resting on the cross-slide, and the constructional details are given in Fig. 3.

The trays are made either from sheet tin or aluminium, or the lid of a cigarette tin of suitable size will serve well as the basis of the fitting.

Wear in an ordinary shaft bearing is prevented by maintaining a film of oil between the opposing surfaces, to that actual metallic contact does not occur; in the same way, the accuracy of the lathe bed will be preserved if the saddle and tailstock ride on a film of lubricant. Ordinary medicinal liquid paraffin is, perhaps, preferable to oil for this purpose, as it is colourless and does not dry or become sticky. It is a good plan to keep an oilcan filled with this liquid near at hand, and from time to time, the bed surface is wiped clean and then relubricated. It is, perhaps, due to the use of chip trays and liquid paraffin that the bed of a lathe we have had in use for eight years shows no sign of wear; even the ornamental scraper marks on the surface, although, perhaps, less than a tenth of a thousandth of an inch in depth, still show quite clearly.

Where the leadscrew is used for traversing the saddle, as well as for screwcutting, every endeavour should be made to preserve its accuracy by preventing unnecessary wear, for with a worn leadscrew, accurate screwcutting is no longer possible.

If the leadscrew is not already furnished with efficient guards, these can be readily fitted in the manner shown in Fig. 1. Here, a guard is fitted at either side of the saddle and the leadscrew is fully protected. The guard shown in Fig. 4 is made from cycle tubing, which, incidentally, has a well-finished surface and can be readily polished. Small brackets are fitted to the guards so that they can be attached to the saddle casting.

When the guard embraces the leadscrew full-circle, the leadscrew must be withdrawn to allow it to be threaded through the guard, but if preferred, the attachment may be of part-circular form so that it can be fitted with the leadscrew in position.

It is advisable to fit some form of lubricator to the base of the forward guard so that regular oiling of the leadscrew will not be neglected.

"L.B.S.C."

(*Continued from page* 596)

dreds of machines. Truly, times change; other folk, other methods.

I need not waste time and space by dilating on the rest of the fittings; a brief mention will suffice. One of my locomotive-type water-gauges, with about $1\frac{1}{2}$ in. of glass between the gland nuts, should be fixed on the shell midway between firebox crown and top plate of boiler, a little to right or left of the firehole. A feed clack should be fitted about halfway up. A 1-in. steam gauge reading to 120 lb. should be fitted near the top, being attached by the usual syphon pipe and union. A blow-down valve, preferably of the "Everlasting" quick-action type described for *Doris*, should be fitted right at the bottom, just above the foundation ring. The firehole door should be of the plain swing type, with a catch of the kind fitted to the domestic oven. If any builder wants to decorate the boiler with any special fittings, there is plenty of room to attach them. For injector testing, don't take steam through the superheater. Screw one of my regular injector steam valves into the shell, as close to the top plate as possible, so as to get dry steam without its being superheated; and fit a special clack, to take the feed from the injector, at any convenient place on the shell, where it is easy to connect and disconnect the pipes.

Our approved advertisers should be able to supply a cast circular grate a full 4 in. diameter, with three legs, to stand in the bottom of the firebox. Alternatively, the grate could be made up, same as a locomotive grate, from $\frac{5}{16}$-in. by $\frac{1}{8}$-in. bars, and cut to a circular outline to suit the firebox, which would be easier than cutting the bars to separate lengths. After using the boiler, simply pick it up with a couple of handfuls of waste or rag, and lift it off the grate. If the boiler is permanently used to drive a stationary engine, a hole could be cut in the baseboard, through which the grate could be removed.

A ring blower should be fitted under the chimney, as indicated in the section, supplied with steam from a valve on the universal fitting. The exhaust from the engine should be turned up the chimney; a pipe connected to the exhaust should be passed through the side of the shell above the top plate, similar to the stem of the universal fitting, and terminate in an elbow, to the vertical part of which a blast nozzle could be fitted, to suit the engine being tested. Well, there is the suggestion for your testing boiler; I hope it meets with approval. It won't be shy of steaming!

The Elements of Maintenance

for 10-c.c. Racing Engines

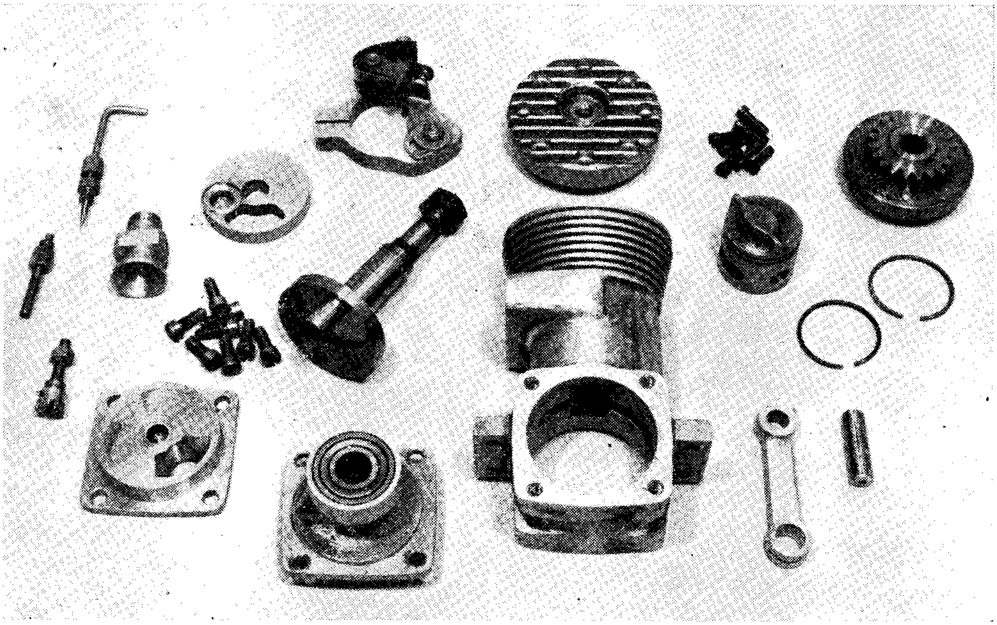
by G. W. Arthur-Brand

A TERRIFIC amount of controversy appears to exist among model racing enthusiasts regarding the general "handling" of small high efficiency racing engines.

In my travels around the country to various meetings, it has been my lot to witness some of the efforts of competitors, especially of model cars, to get their motors purring according to plan. Suffice it to say that I am appalled at the number of models which are brought to starting lines by their owners, who have no idea as to whether or no the thing is going to function, who are almost aghast if it does but who, nevertheless, are usually pastmasters of the art of "brag," in their efforts to convince all and sundry that it was "just a matter of careful preparation!"

Believing that the shortest cut to saving our unfortunate brethren the soul-destroying task of swallowing their false pride can only be conveyed by the voice of experience, this series is being prepared with that very point in view.

In the first instance, I must make it quite clear that I am dealing here with the now well-known 10-c.c. two-stroke racing engine which, during more recent years, has achieved such a high degree of success, not only in model cars, but in hydroplanes and model aircraft as well. A further point I had better make is that this article is not being written for the hardened competitor and hardware collector, the majority of whom receive their instructions from Dooling Brothers, anyway. But it will be of great assistance to the true enthusiast, the chap with the normal-sized head who either makes his own unit and hopes to achieve some success therewith, or has purchased a British unit and is full of enthusiasm for a spot of home support.



A modern 10-c.c. racing engine, completely dismantled pending a major overhaul

Preliminary

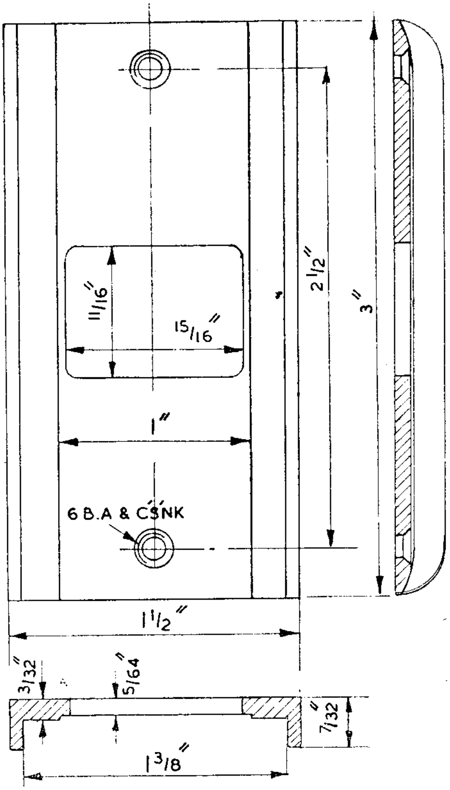
Whatever job your motor has been doing, let us assume that you have taken the usual steps to ensure that every assistance, both human and mechanical, was rendered from the word go. To clarify, the mounting and alignment of a motor is of the utmost importance, and every care should be taken to obviate, for instance, any possibility of side loads on the journal, brought about by improper alignment of propeller or carden shafts and universal couplings.

(*Continued on page* 604)

* Miniature Slide and Strip Projectors

by " Kinemette "

BEFORE finally attaching the stage and spool arm assembly to the front of the condenser housing, a groove or rebate, and also a half-round notch, must be cut in the left-hand edge of the latter to clear the latch plate and pin respectively. The location of the notch can be marked out by laying the stage plate in position and scribing through the latch pin hole; from this the position of the rebate may be determined, and it may be cut either by milling or filing, no special accuracy being necessary, as it serves only as a clearance.



Film guide plate (1 *off, brass*)

Film Guide and Pressure Plates

The method of guiding the film through the focal plane of the projector varies considerably in different types; it is obviously essential that the film should be held perfectly flat, and located in exact focus, while being capable of being pulled through the stage without undue tension. In some cases, optically flat glass pressure plates backed with friction springs are used, but while this method is ideal for ensuring flatness and true location, it calls for specially worked glass plates, with carefully rounded-off entering and leaving edges. Generally speaking, the fewer glass surfaces there are in any optical system, the better for efficiency and brilliance.

Some projectors have a pressure-releasing device which frees the film while it is actually being shifted, but clamps it firmly during projection. But the practical necessity of such elaborate measures may be open to question, as the optical conditions are certainly no more exacting than they are in cinematograph projectors, while the latter have to cope with the greater mechanical difficulties associated with very rapid film movement. It may be taken, then, that the same kind of film guides as used in cine-projectors will be quite satisfactory. The latter consist usually of flat metal plates, of fairly considerable length in proportion to the frame size of the film, and pressed together by springs above and below the film gate. Wherever possible, the plates are so arranged that they make contact with the film surface only at the margins, the central portion, on which the picture is printed, being given a clearance by relieving the surface of the plates, thereby reducing friction, and avoiding abrasion of the picture surface.

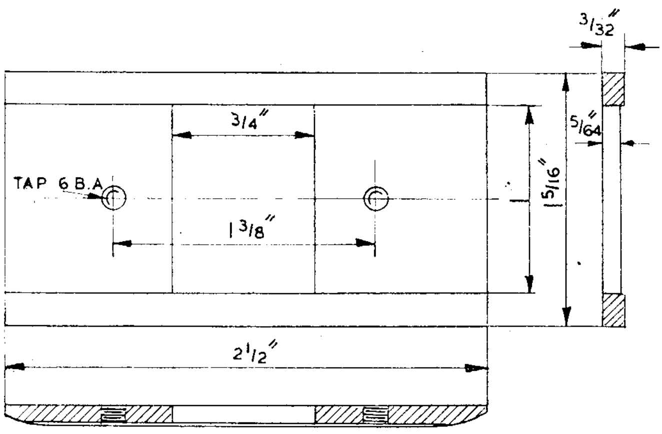
There is, however, one condition which applies to " still " projectors, for which it is not usually necessary to make provision in cine-projectors; that is the possible warping or cockling of the film when held stationary for any length of time under the effect of heat transmitted through the optical system. This may possibly result in some part of the picture surface becoming distorted and displaced from the true focal plane, if there is any appreciable room for it to move between the relieved portions of the pressure plates; and if the distorted portion comes in contact with the relieved metal surfaces when shifted, it may still become scratched or rubbed. In projectors fitted with high-power illuminants, this may in some cases cause a good deal of trouble, and though it is possible to reduce the actual transmitted radiant heat by fitting a screen of heat-absorbing glass in the illuminating system, heat may still be conducted to the film through the metal surfaces.

With the low-voltage illumination recommended for this projector (and providing correct focusing of the lamp and reflector) no trouble with radiant heat transmission is likely, and the entire projector keeps quite cool, so that this trouble does not arise. The only risk to be guarded against is the possibility that films already distorted by passage through a " hot " projector may have to be used; and there is not much which can be done about this anyway, without adding elaborate pressure

*Continued from page 511, "M.E.," April 13, 1950.

control devices, such as mentioned above.

The best material for the pressure plates in this projector is hard brass or bronze, though duralumin is also satisfactory. Stainless steel is often recommended for these components, but if the correct grade is used to ensure good wearing qualities, it is liable to introduce machining difficulty. Brass has the advantage of easy



PRESSURE PLATE 1 OFF BRASS

machining, and its wearing qualities may be vastly improved by nickel or chromium plating of the surfaces. It would be possible to fabricate the plates by soldering on strips to form the side edges, and thin shims for the pressure margins, prior to plating.

However, the machining of the plates from solid material is far more satisfactory, and is by no means difficult if a lathe is available. No special milling attachments are necessary (though they may be applied if available), nothing more elaborate being essential than an angle plate to bolt on the lathe cross slide, and a simple fly-cutter which can be held in the lathe chuck.

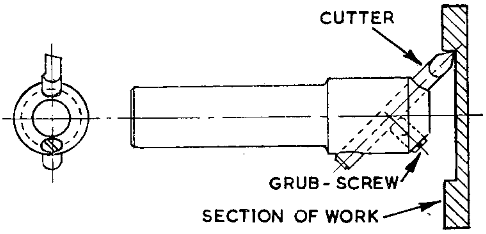
Machining Procedure

The tool used for the operation is a variant of the simple fly-cutter which has often been referred to in THE MODEL ENGINEER, having a shank which can be held in the lathe chuck, and a single-point cutter held at an angle of approximately 45 degrees, and adjustable for radius. It may be mentioned that the tool shown in action in the photograph is somewhat on the light side for this job, having been made long ago for machining the film gate for a 16-mm. projector ; but it performed the operation quite satisfactorily, by taking it easily, and making no attempt to force the pace. A rather heavier shank and holder, as shown in the drawing, are recommended in this case, the holder being $\frac{3}{4}$ in. or more in diameter, with the shank turned down to $\frac{5}{8}$ in., though the latter operation is not really essential. Alternatively, the shank may be made with a morse taper to fit the mandrel socket if desired.

The cutter may be made of $\frac{3}{16}$-in. silver steel, and the hole in the head of the holder should be reamed so that it fits closely and without shake, and can thus be secured quite firmly by the grub screw. A hardened screw of the Allen type is recommended if available. It is advisable to file a flat on the side of the cutter, to ensure that it is always clamped in the correct position relative to the cutting angles, and the latter may with advantage be filed up in position, prior to hardening and tempering, and final honing with a hand slip to a keen cutting edge. A very slight radius should be honed on the tip to enable a good finish to be obtained, and the included angle of the point should be less than 90 degrees, to provide clearance behind the tip on both cutting faces.

It will be seen from the photograph that two small toolmaker's clamps were used to hold the brass plate to the angle plate, and these proved quite adequate to secure it against shifting under the cutting thrust. Any other convenient method of clamping can, of course, be used, so long as the clamps can be kept clear of the path of the cutter, and in this respect it will generally be found advisable to start with wider material than is required for the finished plate in each case, thereby providing a margin for clamping, which can easily be cut away after the machining is completed. This also makes it unnecessary to take very great care in the setting up of the work, though it is a good policy to mark out a centre line on the work and set it as near to the level of the lathe axis as possible.

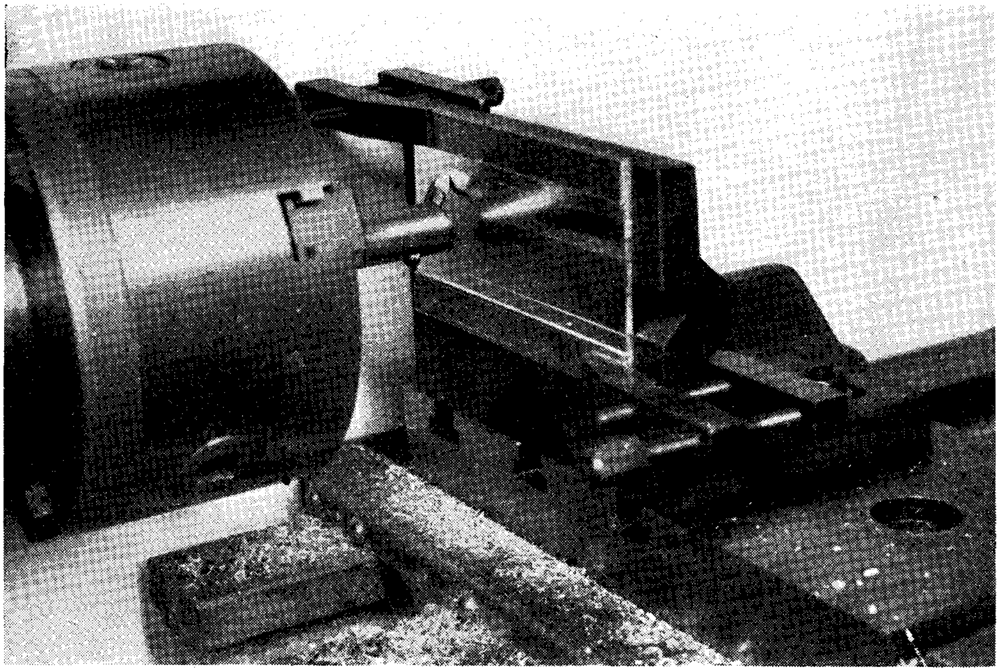
In making the channel section guide plate, a piece of $\frac{1}{4}$-in. thick plate may be used, and the back surface should first be faced dead flat, either by filing and scraping or by taking a facing cut over it in the lathe. This will ensure that it is not distorted when clamped against the angle plate. Some workers may prefer to sweat the plate temporarily to a heavier backing plate to avoid distortion, and this may simplify clamping problems in certain cases.



A simple fly-cutter for machining the film guide and pressure plates

The cutter should be adjusted so that it sweeps a width very slightly less than the finished width of the channel ($1\frac{3}{8}$ in.), which can be done by trial and error, starting with a preliminary cut well under width, then tapping the cutter through a little farther and trying again until the required width is reached. Subsequently,

the work is traversed to produce the full length of the channel, and it is not advisable to try to take very deep cuts or heavy feeds. The lathe may be run at top speed, and if a very light finishing cut is taken with a keen tool, it should be possible to produce a dead smooth finish. It is, of course, practicable to remove the cutter for regrinding if it should be found desirable, but this necessitates careful re-setting to produce the correct radius, and generally, hand honing will deal with any slight dulness caused in the preliminary cuts. If the width is kept slightly undersize, as suggested, the sides of the channel may subsequently be finished by filing, using a dead smooth triangular or half-round file to produce a slight undercut in the corners.



The pressure plate mounted on the vertical side of an angle plate by toolmakers' clamps for machining with the fly-cutter

Before dismounting the work from the angle plate, however, it is advisable to machine the relieved surface of the plate, with the cutter set to produce a width of 1 in., or slightly more if anything. The amount of relief is shown on the drawings as 1/64 in., but as a matter of fact, a clearance of only a few thousandths of an inch is really necessary.

After finishing the guide plate, it may be removed, and the pressure plate similarly mounted (after making sure that this also is flat on the back surface). The thickness of plate used in this case is $\frac{1}{8}$ in., to allow for a skim on both sides. As the cutter is set to machine the relieved surface, this may be dealt with first, cutting a little deeper than is necessary, to allow for the amount afterwards removed when the cutter is re-set to maximum sweep. Finally, the two plates are finished on the side edges, the exact width of the guide plate on the outside being unimportant, and that of the pressure plate being less than that of the channel by an amount sufficient to ensure that it does not tend to foul when the gate is swung open. The friction surfaces of both plates should be highly polished

Frame Apertures

The apertures in the plates are then cut, either by drilling and filing, or end milling; that in the pressure plate is made larger than the film frame, and its accuracy is not important, but great care should be taken with the aperture in the guide plate, as this forms the mask which frames the picture, and any inaccuracy will show up very conspicuously when enlarged 50 or more diameters on the screen. If a vertical slide is available, the aperture may be cut with a $\frac{1}{8}$-in. end mill, so as to leave a clean radius in each corner; but if it is to be finished by filing, the best way is to drill $\frac{1}{8}$-in. holes, as accurately located as possible, at the corners, and file the sides carefully to join the holes exactly on the tangent line. Bevelling away the rear side of the aperture is a good policy, and ensures that the mask is sharply focused with the film picture.

Assembling the Guide and Pressure Plates

The guide plate is attached to the stage plate by two 6-B.A. countersunk screws, and care should be taken to see that the screw heads do not project above the relieved surface of the

plate; the error, if anything, should be the other way, to avoid all possible risk of them touching the surface of the film.

To locate the pressure plate, it should be placed in position on the guide plate, with slips of thin card or paper packing at the sides to centralise it, and the aperture showing a clear margin all round that of the mask. The gate is then closed and latched, and the positions of the holes in the plate marked by scribing through those in the end face of the objective tube, or better still, "spotting" with a drill having a long enough shank, or extension adaptor, to reach from the front end of the tube. Then the pressure plate is removed and the holes drilled and tapped to take the spring guide screws, which were illustrated with the group of latch components on page 509 of the April 13th issue. These screws should fit fairly tightly on the threads, and when finally fitted from the inside of the objective housing, their points must not project above the relieved surface of the pressure plate; if necessary, they must be filed flush after assembly.

With the screws fitted, the pressure plate should move freely within the limits allowed by the length under the screw heads; if not, the holes in the end face of the objective tube must be eased until they do. The springs fitted behind the pressure plate should be just strong enough to ensure firm contact with the guide plate, but not to grip so tightly that there is risk of damaging the film when it is pulled through.

A Successful Demonstration

Readers may be interested to learn that this projector has made a public appearance, before a fairly large audience, at a lecture organised by a well-known society of model engineers, where it created considerable interest, and behaved quite satisfactorily. The lamp used was the exciter lamp which is seen in the photograph published on page 430 of the March 30th issue, and the projector was in use for well over an hour, projecting a picture about 5 ft. wide. Criticisms were invited, but both the brilliance of illumination and the quality of projection were very favourably commented upon. A second demonstration to another model engineering society at a later date was equally successful, though in this case the duration of the test was shorter, as the proceedings were impromptu and informal.

Many of the correspondents who have expressed serious doubts as to the efficiency of the illuminant recommended for this projector may be reassured by the result of these demonstrations. Some readers have suggested that the power of the illumination should be as high as 750 watts for serious lecture work; but it is believed that the majority of readers who require a miniature projector will be satisfied by the standard of illumination specified. A high-power lamp involves special problems in the dissipation of heat, and even if the lamphouse is larger and well ventilated, the radiant heat transmitted through the optical system cannot be completely eliminated, even by the use of heat-absorbing screens. In extreme cases it may even be found necessary to provide for cooling the film gate by a powerful air blast to prevent blistering or scorching of the film.

(To be continued)

The Elements of Maintenance for 10-c.c. Racing Engines

(*Continued from page* 600)

The exhaust port, when not in use, will have been kept well covered (preferably with a moulded rubber cap or adhesive tape but never a cork, which tends to collect foreign bodies for future deposition, together with bits of its own fragments, in the combustion chamber) and only well mixed and strained fuel of the correct variety and very best grade will have been employed.

It will be assumed, too, that a careful note has been kept of engine performance, needle-valve settings, speed fluctuations and starting propensities at various temperatures and estimated humidities.

Now if you have taken all these precautions and satisfied yourself that the unit is still in good health and not suffering from any chronic disease such as a broken ring (with its attendant scored liner), bent crankshaft, bent connecting-rod or obviously worn-out big-end or rotary-valve bearing, there can be only one possible reason why you are contemplating an overhaul: improved performance.

Again assuming that you have never tampered with the "innards" in any way, your first line of attack should be to procure a table in a quiet corner away from the kids. With a sheet of clean paper spread over the top and a packet of envelopes, the necessary tools, a pencil and a clean rag handy, you are ready to get to work on the complete stripping of the unit. We are going to carry out a major overhaul, so it is essential that every part be dismantled, cleaned, and filed away in an envelope to ensure freedom from contact with other parts. Each envelope should be clearly labelled and a stout shoe box will be found an excellent container or "cabinet." In this way each part may be inspected separately and the findings added to the envelope.

In the next instalment we will commence to take each component in turn, inspect it, check it and carry out any modifications we may think necessary for the inducement of increased performance.

(To be continued)

*The "B.R.M."

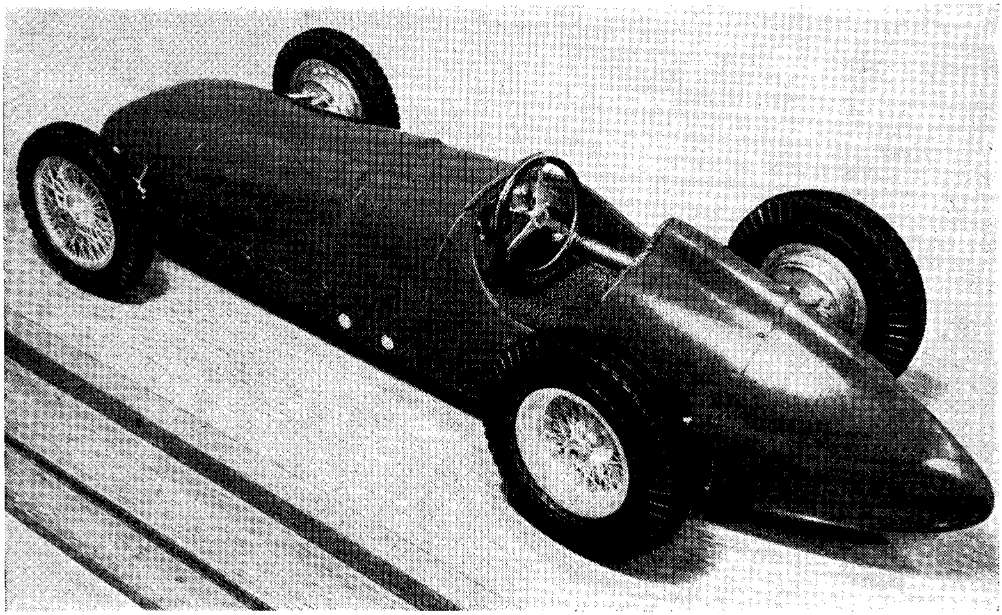
Its Construction to 1/10th Scale

by Rex Hays

HAVING arrived, in my last article, at the body outline and section of the B.R.M., the next thing was the actual construction which in this particular case was entirely straightforward. As this model was to be a glass-case replica and not powered, the extremities of nose and tail were carved in beech, and, as previously mentioned, the sections which were formed to create the mock-up were used as templates for the front scuttle, front of cockpit and rear of cockpit bulkheads. The two remaining templates, namely rear of radiator cowling and at the join of the tail, were used in the forming of these finished parts.

The body panelling was then formed to the outline of the bulkheads in exactly the same manner as the paper mock-up was built, only from rather more suitable material and in more permanent fixing.

Now, to deal in detail with every phase of the construction of this model would take many thousands of words, and so I think that it may be more interesting to consider what is known of the technical details of the B.R.M., and how I dealt with representing them in the most faithful manner.



Note the long slender appearance of the tail from this angle, and the low set of the steering-wheel

The Rear Suspension

This, for example, is typical Grand Prix de Dion, almost exactly similar to the 1938 Grand Prix Mercedes Benz, in fact, from the windscreen back to the extremity of the tail, the whole car bears a close resemblance to this famous type.

Now the Grand Prix de Dion suspension is composed of three main features—the de Dion tube, the radius arms and the half shafts with the hook-type outboard universal joints.

These components in themselves were by no means difficult to represent, but the convincing assembly of wheels, brake drums, hub-nuts, plus the de Dion details were quite a different matter, more especially as the brake drums and all the suspension parts were to be dull-plated and semi-polished.

Photographs of the car showed the brake drums to have a series of holes drilled on the wheel side, and holes drilled in solid drums I did not consider would be convincing, therefore, the drums must obviously be hollowed from the back, leaving sufficient metal in the centre of

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**Continued from page 552, "M.E.," April 20, 1950.*

each drum through which to drill a hole and tap it with a 2 B.A. thread (Fig. 1), next came the hub-nut which was turned out of the solid, filed to shape and a corresponding thread cut on the extension of it (Fig. 2). Thus the brake drum could be screwed to the wheel hubs by

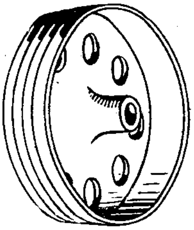


Fig. 1

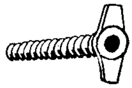


Fig. 2

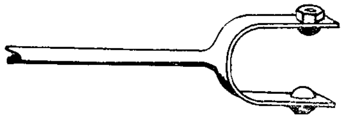


Fig. 3

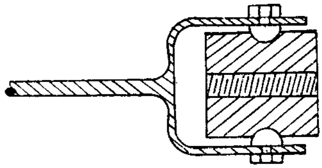


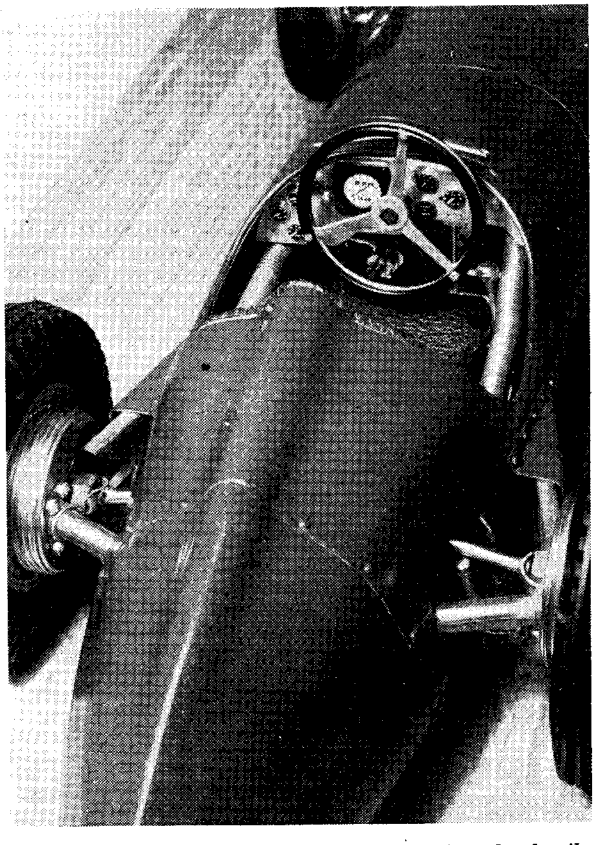
Fig. 4

the hub-nut. Next a backplate was turned up and fitted over the threaded extension of the hub-nut to the back of the brake drum : now, by making the back plate detachable, all the de Dion components could be bolted to it, with the exception of the universal joint on the half shafts.

Looking ahead to the assembly, it became obvious that the whole rear suspension unit could not be completed and then fitted to the body and chassis, as, in the first place, the radius arms had to enter the body at an angle that made it quite impossible to cope with the de Dion tube ; thus, it became apparent that the two wheels must be joined by the half shafts before the radius arms were bolted finally to the back plates ; moreover, the wheels had to be completely detachable to allow any assembly to take place at all. Now this was all quite a problem, and I overcame it in the following manner :

I utilised the threaded extensions of the hub-nuts which were protruding through the back plate, and by tapping a thread through the half of the universal joint, which is partly encompassed by the hook, I screwed it tight up against the back plate : thus the hub-nut joined wheels, brake drums, back plate and universal, but because the wheels must be detachable for fitting the remainder of the suspension, I could not bolt or solder the hooks of the universal to their other halves. To overcome this complication, I decided that, as these were universal joints, they had better be, at any rate, partly what they were intended to represent, namely, universal joints ; consequently, I drilled holes in the hooks and having rounded the heads of four 12-B.A. screws, bolted them into position (Fig. 3). Next, I drilled two deep dimples on either side of the threaded main universal fixing, and sprung the hook bolt-heads into the dimple recesses (Fig. 4).

Next, the radius arms were formed, and a hole drilled in their rear section, so that for the final assembly, these radius arms could be bolted to the chassis frame inside the cockpit, having first, of course, been bolted to the back plate when it was detached from the drums. Now to the extension of the radius arms I soldered a piece of tube filed off at the correct angle. It was into this tube that the de Dion tube would register when eventually both rear wheels



An excellent close-up of cockpit and back axle details. Note the armoured fuel lines running along cockpit sides

were drawn together by screwing up the hub-nuts. Then the whole assembly which comprised the radius arms with the backplate attached, would fit to the hub-nut extension, and the de Dion tube having been lined up and bolted to the tail bulkhead, would fall into position as the wheel nuts were tightened, using the universal joints on the half shafts as the nuts for securing the whole of the rear suspension layout.

Before the final assembly, a small bracket had to be soldered to the extension of the radius arms on the underside for the fitting of the oleo-pneumatic strut arm.

The whole de Dion suspension can be seen in the close up-photograph of the rear end of the B.R.M., the hook type universal joints, the de Dion tube, radius arms and the oleo strut being plainly visible.

(To be continued)

Queries and Replies

Enquiries from readers, either on technical matters connected with model engineering, or referring to supplies or trade services, are dealt with in this department. Each letter must be accompanied by stamped, addressed envelope, and addressed: "Queries Dept.," THE MODEL ENGINEER, 23, Great Queen Street, London, W.C.2.

Queries of a practical character, within the scope of this journal, and capable of being dealt with in a brief reply, will be answered free of charge.

More involved technical queries, requiring special investigation or research, will be dealt with according to their general interest to readers, possibly by a short explanatory article in an early issue. In some cases the letters may be published, inviting the assistance of other readers.

Where the technical information required involves the services of an outside specialist or consultant, a fee may be charged depending upon the time and trouble involved. The amount estimated will be quoted before dealing with the query.

Only one general subject can be dealt with in a single query; but subdivision of details into not more than five separate questions is permissible. In no case can purely hypothetical queries, such as examination questions, be considered within the scope of this service.

No. 9796.—"Surplus" Vacuum Pumps R.J.L. (Hereford)

Q.—I have purchased a "surplus" vacuum pump (rotary vane) which I wish to use for supplying air for a spray gun, etc. As apparently the pump has to be supplied with oil all the time, how can I keep it from the air line? Is an air reservoir necessary? How is surplus pressure controlled when valve on spray gun or blowpipe is closed?

R.—The rotary type of air pump is not suitable for working the usual high-pressure type of spray gun. This type of pump is not usually intended to work pressure differences exceeding 15 lb. per sq. in., and its best efficiency is obtained at much lower pressures than this. It is possible to use a low pressure of air with a special type of spray gun, but we cannot inform you where such a spray gun could be obtained.

With regard to the matter of lubrication, rotary pumps of this type, which are originally intended to work at pressures below atmospheric, are capable of conserving the oil by drawing it back into the suction side of the pump from a separator on the discharge side. It is doubtful whether this recovery system would be fully effective when working the pump under pressure, but it might be possible to reduce the supply of oil very considerably and thus minimise the difficulty of keeping it in the delivery line.

The risk of oil coming over with the air is, however, much greater with this type of compressor than with the reciprocating type, and it is most essential that the air should be perfectly clean for paint-spraying purposes.

No. 9786.—Building-up Metal Surfaces J.F.V. (Llanidloes)

Q.—I have a small 2-in. precision lathe by Lorch, of pre-war date, which I am anxious to restore to its original condition, in order to preserve it as an example of this type of lathe. Unfortunately, it has two rather severe bruises in the bed. To re-scrape the bed to the extent necessary to eliminate the bruises would, possibly, entail the removal of too much metal. Can you advise me whether it is possible, by electrolytic, or other methods, to build up the defective places, which are of small area, and if so, can you give me the name of any firm who would do this work for me?

R.—It is possible to build up metal surfaces, either by electro-deposition or metal spraying, but in either case, the finishing process needed to restore the original flat surface would be fairly expensive, probably much more so than having the entire surface re-ground and scraped. We suggest that if the damaged areas are fairly small so that the slides are not deflected in passing over them, it would be sufficient just to remove surface roughness from them, without attempting to produce an unbroken accurate surface. The only objection to this would be on the score of appearance, but it may be noted that in the case of building up, the appearance of the damaged portions would still be different to that of the rest of the bed. Messrs. Fescol Ltd., 39, North Road, N.7., carry out electro-deposition processes, and metal spraying is done by Metal Sprayers Ltd., Carlisle Road, London, N.W.

No. 9794.—Materials for Domestic Refrigerator
V.F. (Preston)

Q.—I have read with interest the articles relating to a Domestic Refrigerator by L. C. Sherrel, and there is one thing that puzzles me in the paragraph which appeared in the December 1st issue, page 686—" Aluminium joints or joint rings containing graphite must not be used, as they are affected by the gas." Does this mean that anything in the nature of aluminium must not be used, such as an aluminium piston or crankcase? I have in my possession a compressor similar to the one described, but having aluminium piston and crankcase. Could I use the compressor as it is or not? On the other hand, do you think it would be worth while substituting C.I.?

R.—It is generally undesirable to use any aluminium in a refrigerator for any parts which may come into contact with the refrigerant gas. Although some of these gases are chemically inert in their pure state, it is often found that impurities set up chemical reactions which are very destructive to aluminium and certain other metals. The compressors used in refrigerators are generally made of iron and steel wherever possible.

No. 9799.—Ex-Government Camera Guns
L.E. (Winchester)

Q.—Could you please give me some information on how to convert the camera guns which Aero Spares have advertised into cine-cameras. I cannot see how this is possible as these are made at present.

R.—The camera to which you refer is already a cine-camera which is capable of taking 16 mm. moving pictures, at the standard rate of 16 frames per sec. As such, it requires practically no conversion, though it would be an advantage to fit some form of focusing device on to the lens to enable near objects to be brought into focus.

Unlike the ordinary hand cinecamera, however, which has a clockwork drive, this type of camera is electrically driven, and a rather complex connecting block is used for the current supply which might need some modification to adapt it to the purpose of a portable hand camera. It would, of course, be necessary to carry a battery of the appropriate voltage for the driving motor.

No. 9800.—Rust-Removing Chemicals
R.W.K. (Liverpool)

Q.—Upon the advice of one of the model shops in this city, I am writing to ask if you can help me to find out the name, etc., of a rust-removing liquid. Soon after the end of the last war, I was given a bottle of liquid by an officer in charge of an establishment whose business was the cleaning and storing of army tools. One either dipped the article to be de-rusted in the liquid or painted it on to larger things and then washed off in boiling water or steam jet. About eighteen months ago I read in the newspapers of a marvellous new rust-killing liquid being exhibited at the " Britain Can Make It " fair, but no trade name or manufacturer was mentioned. I have tried unsuccessfully to trace this liquid.

R.—We have been trying to trace the preparation referred to, without, however, obtaining any success. Most authorities are of the opinion that any chemical which removed rust by dipping or similar application would have to be of a corrosive nature, and might, therefore, be liable to set up an even worse chemical action. The great majority of rust-removing preparations are in the nature of a penetrating oil, and merely loosen the rust so that it can be removed by friction.

No. 9791.—Balancing Crankshafts
L.G.W. (Felixstowe)

Q.—I have constructed a 50 c.c. o.h.v. petrol engine of free-lance design, but find that I have an excessive amount of vibration which I can only attribute to an incorrectly balanced crankshaft. My problem is, what components are necessary for balancing? The engine has internal flywheels and, as a roller big-end bearing is fitted, I assembled the unit complete with bearing less connecting-rod, and mounted it loosely in lathe centres, obtaining a perfect state of balance. Should the connecting-rod have been included? The unit naturally had to be stripped to assemble connecting-rod but was returned to original setting. Both connecting-rod and piston are of dural.

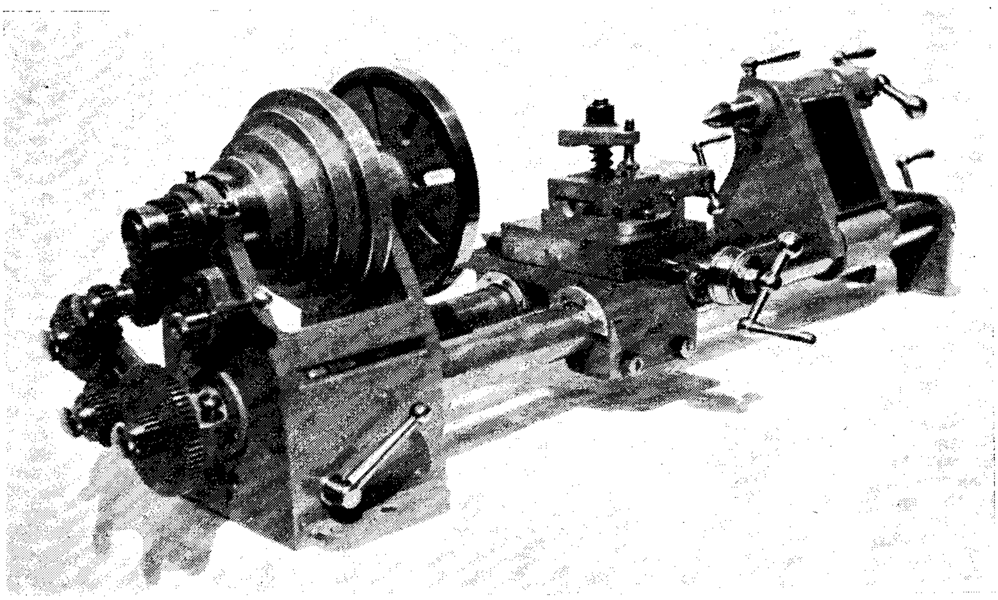
R.—It is always necessary to take into consideration the weight of all moving parts of the engine in order to arrive at the amount of balance-weight necessary. It will, of course, be appreciated that absolutely correct balancing of a normal single-cylinder engine is impossible, owing to the fact that a rotary balance-weight can only balance a reciprocating weight when its plane of motion is exactly equal and opposite to the latter. When the balance-weights are moving approximately at right-angles to the plane of the reciprocating forces, at or near the dead centres, they are themselves unbalanced, and, therefore, produce vibrations in a plane at right-angles to the stroke. What is aimed at in balancing is to first of all reduce the unbalanced forces in any particular plane as much as possible, and also to dispose them in such a way that they have the minimum effect on the engine structure. To do this, it is usual to balance out about half the reciprocating weight to the whole of the rotating weight. The reciprocating weight is usually taken as that of the complete piston and gudgeon-pin, and rings plus the top end of the connecting-rod. The rotating weight is the whole of the crank pin and crank webs, big-end bearing and lower half of the connecting-rod. For the very best results, some experiment with the amount and disposition of the balance-weight is nearly always necessary.

PRACTICAL LETTERS

A Home-made Lathe

DEAR SIR,—I thought that you and your readers might be interested in a photograph, and a few details of a 4-in. lathe I have made for myself.

Not having the means of machining a bed, this was made up of two lengths of 1½-in. mild-steel shaft; the headstock and tailstock being fabricated from ½-in. mild-steel plate welded together. Patterns were made for castings to complete the various parts of the saddle.



The ⅝-in. leadscrew is a square thread, 8 t.p.i., and is engaged or disengaged by means of a sliding dog, actuated by handle on front of the headstock. A handle at end of leadscrew operates the saddle.

The surfacing slide has an Acme thread, 10 t.p.i., with a scale reading one hundred divisions of 0.001 in. The compound can revolve the full 360 deg. and has a scale engraved up to 180 deg.

With a made-up cutter and jig, and using other wheels as my dividing head, I cut a set of change-wheels to give threads from 8 to 40 t.p.i.

No. 2 Morse taper is used for headstock and tailstock. The mandrel is hollow, having 19/32-in. bore.

In making, five ½-in. steel plates (two for headstock, two for tailstock and one for end of bed) were bolted together and the holes were bored in a lathe. The normal tumbler reverse is used for the leadscrew.

The tailstock slides on a cast-iron base, but clamps down rigid wherever required, but it cannot be "set over." Its spindle is engraved with a depth scale in inches and self-ejects the centre or drills.

I have no back-gear (I'm sorry I did not include this), but have four steps for the V-belt, and drive the countershaft at two speeds, thus giving eight speeds in all.

Length between centres ..	17 in.
Swing over bed	8¼ in.
Swing over saddle	4 in.

The whole has proved very accurate and rigid.

Yours faithfully,

Hamilton, N.Z. F. TONAR.

Planing Thin Pieces of Wood

DEAR SIR,—Turning over some back numbers I saw recently, several suggestions for planing small and very thin pieces of wood. All the suggested solutions seemed to me very elaborate compared with the one I have always adopted: *viz*, obtain a piece of flat board of any convenient size which can be held in any of the more usual ways and rub the surface liberally with chalk, place the piece to be planed on the chalked patch.

When commencing each stroke, be sure to place the nose of the plane down first with firm pressure; a little practice will enable anyone to plane the piece down almost to the last shaving. A wood plane is best, as there is less friction, but it can be done with a very blunt, steel plane.

Yours faithfully,

Cardigan. G. G. BARNARD.

The Goyen Lathe

DEAR SIR,—The letter from Mr. E. W. Fraser of Luton in the March 23rd issue of your paper, is of great interest. Your readers might like to know that W. Goyen of Newton Abbot is said to have made eleven of these tools during his lifetime, and at present, the Society of Ornamental Turners, knows of the whereabouts of five of them.

Until a few months ago, one of them was in my custody awaiting a purchaser (it has now been sold), and during the time I looked after it, I had the use of it. There is no doubt of its suberb workmanship throughout. In addition to being a usual pattern of engineer's lathe, it had in its equipment a second special headstock on which could be done the full range of ornamental turning as well as medallion work. It was made in 1873 and cost a little over £1,500, a substantial sum for those days.

I have been told, but cannot verify it, that Goyen took over six months on each of the lathes he made, getting the bed truly in line and flat. These tools are so good that even after, say, 75 years of use they command a four-figure price, provided, of course, they are in good condition.

Yours faithfully,
The Society of Ornamental Turners,
NORMAN TWEDDLE,
Harrow. *President.*

DEAR SIR,—I was interested in Mr. Fraser's letter, as I have copies of these two photographs, and the lathe partly shown in the right-hand side of the Goyen in the lower photograph, is a very fine Holtzapffel Rose Engine and Ornamental Lathe (made in 1836), which is now in my possession and has been for the last 25 years. Apparently a previous owner had both these lathes in his workshop where the photographs were taken.

I have been told that Goyen made thirteen lathes, all of which were of the same elaborate kind, fitted with a great deal of apparatus, and with superb finish.

One of the best of these Goyen lathes was recently in the workshop of the president of the Society of Ornamental Turners, and a second one is owned by another member.

Yours faithfully,
Croydon. G. HINDES.

Stationary Steam Engines

DEAR SIR,—I was delighted to read the article by Mr. Barker on his beam engine and especially to find that the drawings had been included. It occurs to me that many of your readers whose tastes lie in the same direction as my own, would welcome a series of articles on stationary steam engines covering a representative range of types, more especially if general arrangement drawings could be given.

I have always been pleased to read the articles of this nature which have appeared sporadically in your journal. Perhaps other readers would give their views.

Yours faithfully,
F.W.C.

Suitable Steels for Steam Engines

DEAR SIR,—May I supplement your reply to querist No. 9783 in THE MODEL ENGINEER for March 9th by my experience with the "Tich" series of flash steam hydroplanes about 10 years ago? With reasonable precautions in the care of an engine during and after running, your querist need not fear "the rusting of cast-iron parts," he mentions. If, when running, the engine is properly lubricated, then the combined effect of oil and hot steam (and it *is* hot sometimes) produces a smooth velvety polish on all the contacting surfaces of the working parts. I have always believed that there is a small degree of permanent impregnation of the oil into the metal—more so in cast-iron than in steel—which is certainly no disadvantage.

The materials which have given me every satisfaction are :—

Bearings ..	.. Cast-iron.
Cylinder ..	.. 3 per cent. nickel-steel.
Piston ..	.. Cast-iron.
Piston valve..	.. Cast-iron.
Connecting-rod	.. Aluminium alloy.
Crankshaft ..	.. A 3 per cent. nickel chrome case-hardening steel identified as BSS 682.

This last steel can be case-hardened readily for use with the big-end and bearing bush and always possesses a very tough core.

The above materials are suitable for both high and low performance steam engines of the type to which your querist refers.

Yours faithfully,
Enfield. H. J. TURPIN.

The Traction Engine Interest

DEAR SIR,—THE MODEL ENGINEER of February 9th reached me over six weeks after publication so this makes explanations a bit stale. However, after reading the paragraph in "Smoke Rings" and letters from readers pointing out that I erred in stating in my previous note on "Removable Boiler Tubes" that "Robey's did not, it *seems*, build traction engines," I am now convinced that one cannot be too careful when writing about steam road traction. "Black mark!" as Jim says to our Dick Bentley.

What a large number of readers must be interested and well-informed on this subject! I see that there are others who have fallen (Mr. D. C. Allen and his chimney on "General Buller"). My mistake was in thinking I had a complete catalogue of Messrs. Robey's products. This rather large catalogue contains pictures and details of horizontal, vertical, undertype, overtype, and portable engines but no road traction engines, and although, during my travels in Australia, I have seen many portables and traction engines, I have not been lucky enough to find a Robey, but I shall certainly keep my eyes open in the future. Thank you, Mr. Holden, Mr. King, and all the people who have written to the Editor ; it is indeed a healthy sign that shows how keen readers are on this, shall I say, historical subject.

Yours faithfully,
Mitcham, South Australia. V. H. MESSER